SCIENTIFIC AMERICAN

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THE MANUFACTURE OF ARTIFICIAL LIMBS.

It would be hard to find a more beneficent example of the progress of mechanical science than that afforded by the peculiar industry we describe and illustrate in this issue. The artificial limb manufacturer ranks, in a sense, with the reparative surgeon in the good he does to humanity. Especially at the present day his operations are of importance. The cases of amputation are getting more and more frequent. Trolley cars, steam railroads, agricultural machinery and factories are all responsible for many accidents, and naturally they are increasing in number. In early days the old peg leg of the Peter Stuyvesant type represented the best substitute for the natural member. The hook of Captain Cuttle recalls the substitute for the other members in vogue some years ago.

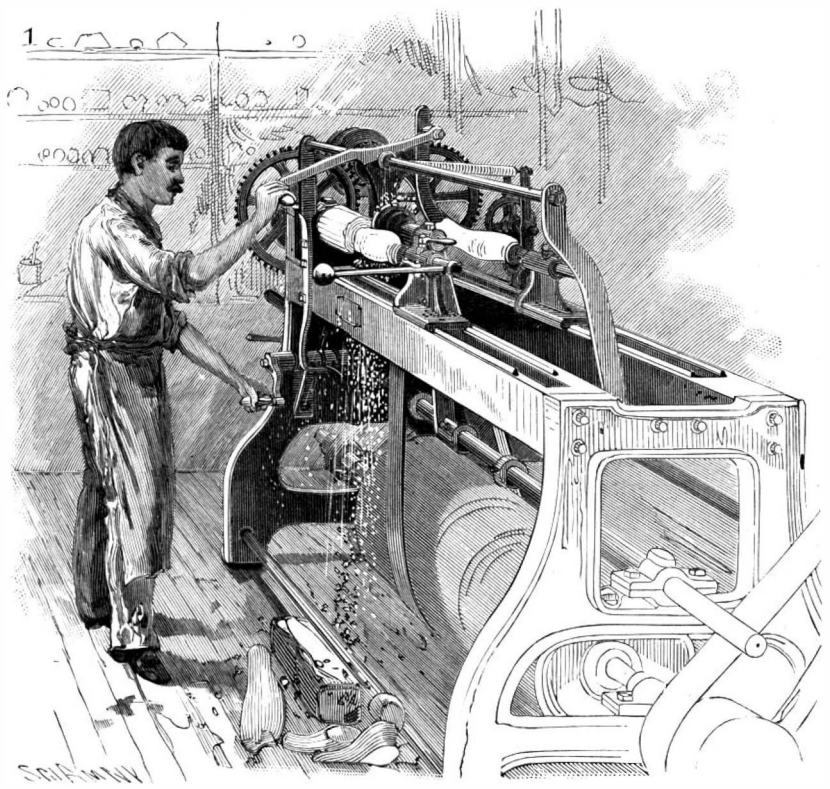
Manufacturers of these primitive affairs attempted to improve their product, and produced arms and legs with joints. The complicated natural leg was the model, and efforts were directed to reproduce its many motions. Much ingenuity was expended in this direction, and in due course of time, through simplification of its parts, the structure, as has been aptly said, "passed through all the possible stages from the leg automaton to the leg practical." The object of this article is to show how the artificial leg of the day is made, and our sketches have been made at the establishment of A. A. Marks, of New York City. A curious collection of envelopes is framed and displayed in the office of the firm—envelopes addressed to them and which inclosed correspondence from every country, and which would in many cases be treasures to the philatelist. They are exhibited to show how the entire world draws upon their factory for artificial limbs.

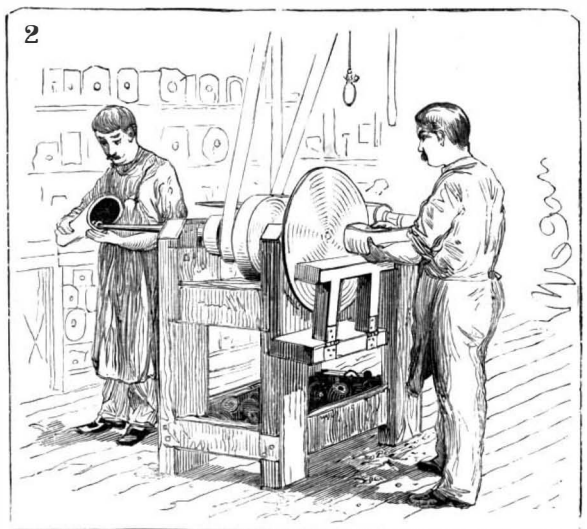
The leg with restricted back and forward ankle motion was constructed by Mr. A. A. Marks during the interim 1853-1863. The joint included a spring adjustable for tension and provided compensation for wear. The experience of ten years showed that the ingenious and much praised ankle joint was too weak for hard service, and repairs were very frequently required. A patient applied to Mr. Marks for a new foot without ankle joint. The idea, opposed to preconceived notions, was carried out with some difficulty and the problem was practically solved. Now, except in very special cases, the ankle joint is definitely abandoned, and the India rubber foot, the result of a vast number of experiments, patented and controlled by this firm, is employed.

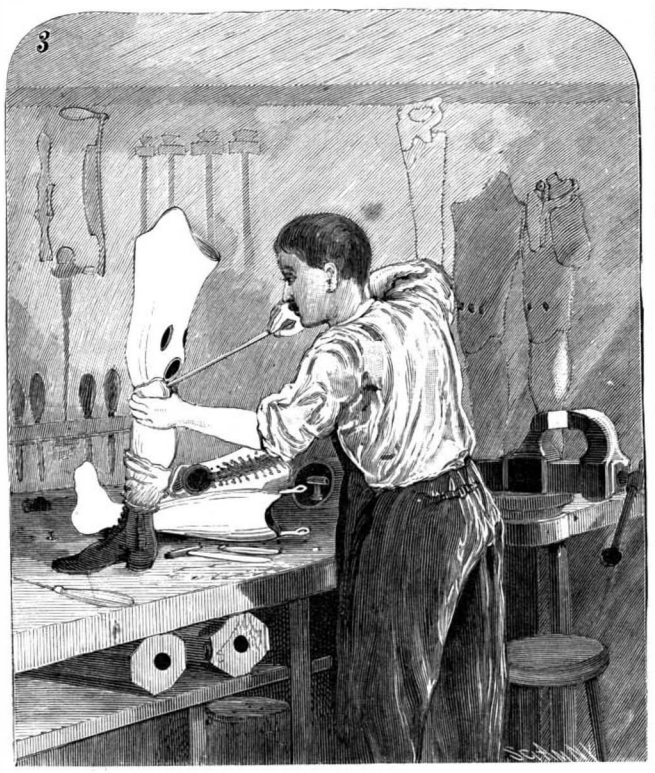
The first step in the process of leg making is the cutting of the timber. Two kinds of wood are used—the willow and the bass. These are felled with saws, are cut into short lengths, and an auger is driven through the axis of each log. The wood is kiln dried in live steam at a pressure of eighty pounds to the square inch. The endeavor in boring out the axis of the log is to provide for internal contraction, thus preventing checking. Several years' seasoning are given.

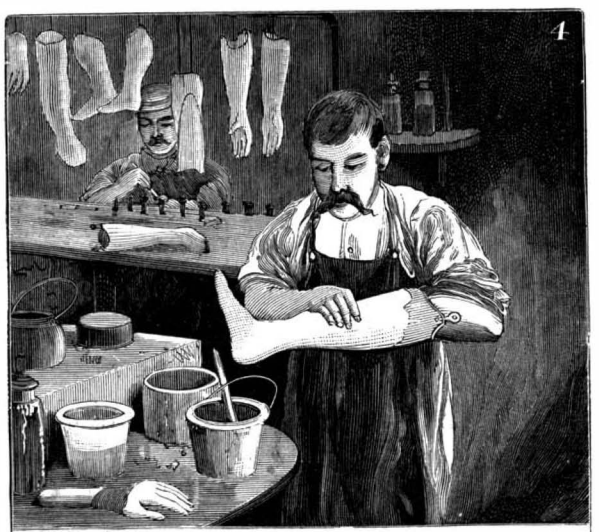
The seasoned wood, which has been roughed out with a buzz saw, is received in the factory and is ready for the workman. Fig. 6, g, shows a log prepared for the shaping process. The workman has to give the interior a shape representing the contour of the stump on which the shape is based. With peculiar carving tools, illustrated below (Fig. 6, a, c), the interior is rapidly excavated until the approximate shape is reached. As guide or template for the interior, two pasteboard profiles (Fig. 6, d) of the stump are used, together with paper rings (Fig. 6, e), giving the girth of the stump at different places. The exterior is brought to shape by the drawing knife for the first steps, followed by the gouge (Fig. 6, b), spoke shave, rasp and sandpaper successively. The operation of carving the exterior of the leg is shown in one of the cuts (Fig. 5). The interior is brought to its final shape by revolving sand wheels which smooth it out to precise contour. The wheels, made of glue and sand on a core, are carried on the end of spindles rotated at high speed by power, and these are moved about against the interior of the leg until it is finished. Coarse and fine wheels are used. The operation is shown in Fig. 2, in which also is seen a workman facing off the end of the leg to receive the foot.

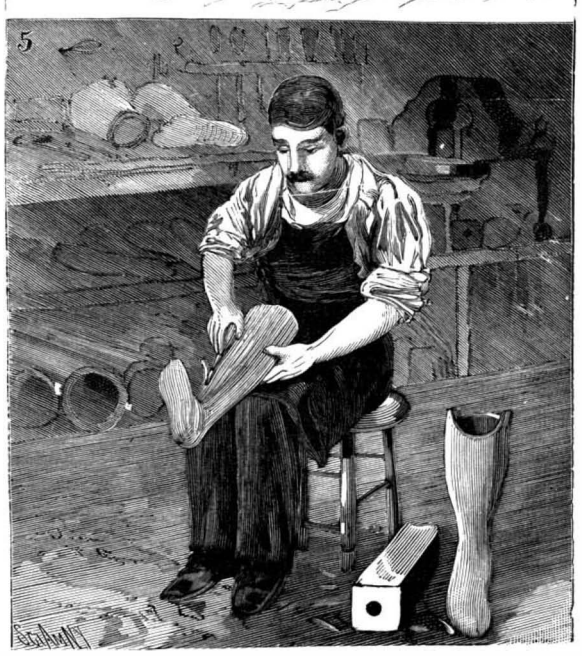
The foot is made upon a wooden core which extends down below the instep. The lower portion of the foot and the extension to the toes are made of sponge rubber, fortified with several layers of canvas embedded in the mass. The foot is rigidly secured to the ankle end of the lower limb by a sort of mortising. Sometimes the section of a log is turned out on a shaping machine from a template or duplicate, and one of the cuts (Fig. 1) shows this machine in operation.

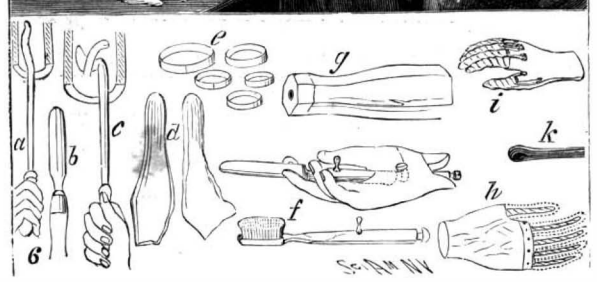












1. Shaping machine turning a leg section. 2. Finishing interior of leg and facing off ankle end. 3. Setting up legs. 4. Finishing legs and arms. 5. Carving leg sections by hand. 6. Details and parts of artificial limb making.

THE MANUFACTURE OF ARTIFICIAL LIMBS.

The leg is covered with rawhide tightly stretched over the outside of the wood; the foot is covered with white calfskin cemented on the upper surface and lapping over the sole. A sole is cemented on and is sewed all around the edge to the upper covering. The foot and leg are now enameled and dried in an oven. This leaves them waterproof for all ordinary purposes. These operations, one of which is shown in Fig. 4, are termed finishing.

But for special cases, where water is to be feared, a log is selected whose natural grain follows the curve of a leg and foot. From such a piece the entire lower leg and wooden core of a foot is made all in one piece, and the rubber portion of the foot is attached

(Continued on page 68.)

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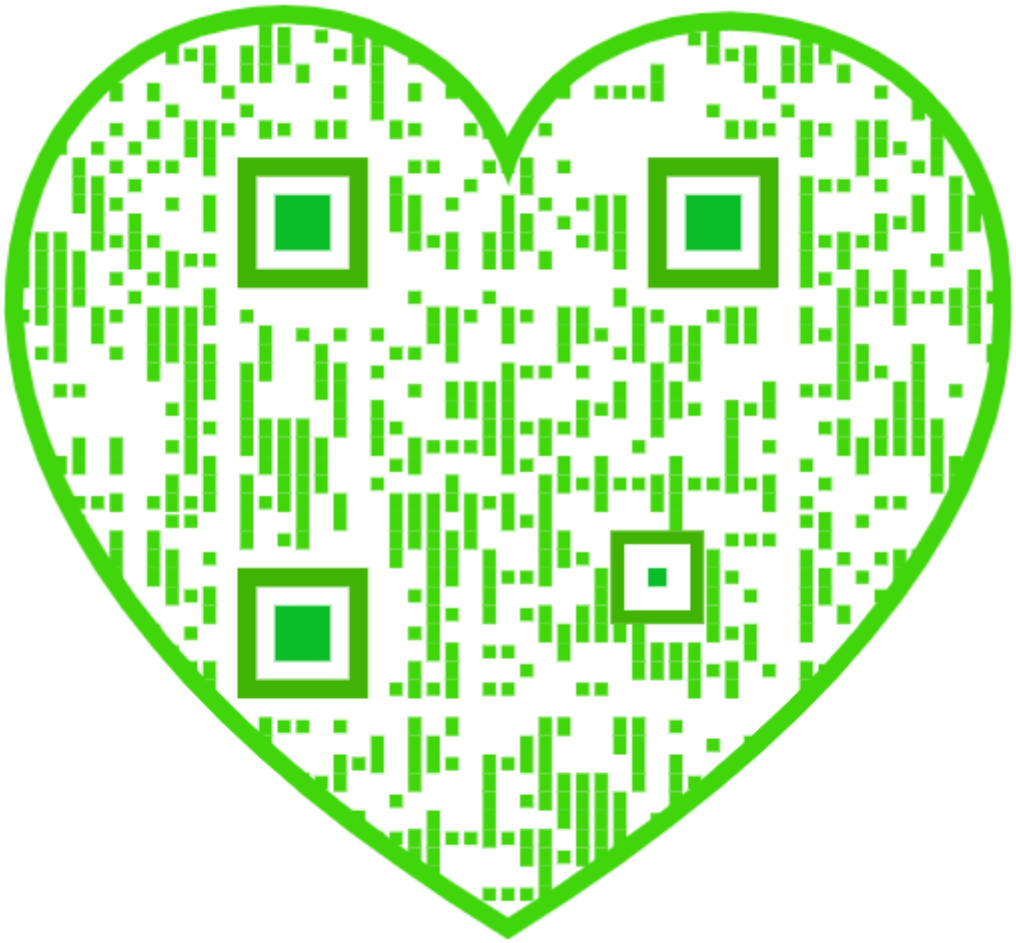

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THE PHYSICS OF THE BICYCLE.

When a wheelman is moving forward on a bicycle, what keeps him up? That is the question asked by inquisitive minds, as the rider passes swiftly along on a wheel base practically without width. Sitting on a still wheel is an almost impracticable feat; but it is simple enough to maintain an upright position when moving at a very slow speed. It is a physical fact that a body in motion persists in maintaining its plane of motion, and unless some additional force acts on the body at an angle to the original line of motion, it will continue to move in its original plane until stopped by friction or arrested by an obstruction. A body set in motion tends to move in a straight line, and will do so unless affected by a force acting on it in a different direction from that of the first movement.

To illustrate this point we might refer to the rim of a flywheel, which moves in a certain plane, but not in a straight line, because it is confined to a circular path by its spokes. Should the flywheel burst, its parts would fly off in paths that would be perfectly straight but for the force of gravity, and it is only too well known that these pieces are not easily deflected from the paths taken by them at the moment of the explosion.

A wheelman is propelled through space at a velocity sufficient to cause him to maintain his plane of movement. Should he desire to change this plane of motion, as in describing a curve, he can do it only by calling in the aid of gravity, i. e., he must lean to the concave side of the circle, more or less, according to the radius of the curve he is following. And further, in describing a curve, he is impelled outwardly by centrifugal force, which is more or less, according to his velocity, and he must oppose this force by a centripetal force, which in this case is gravity. This he does also by inclining his body toward the center of curvature of the path he is describing. In this case the wheel sometimes forms a considerable angle with the ground, so that under some conditions it slips from under the rider. It is in view of this fact that the circular bicycle race track at Manhattan Beach, Coney Island, has lately been constructed with a considerable downward inclination toward the center, so that wheels spinning on this curved track would be more nearly at right angles with the surface on which they roll.

The ability of a bicycle and rider in rapid motion to do serious damage in a collision with another machine or with a pedestrian is fully appreciated by few wheelmen. A man weighing 150 pounds and moving at the rate of ten feet per second (which is only about seven miles per hour) has a momentum of 1,500 pounds, leaving out of the account the weight of the wheel. This is sufficient to upset any pedestrian with terrific force. It has been suggested that the pneumatic tire forms a sort of fender which would prevent serious concussion in case of a collision. It would undoubtedly have a slight modifying effect, but it would be of little account. A collision between two wheels, each with a 150 pound rider, spinning at the moderate speed of seven miles per hour, would result in a smashup with a force of 3,000 pounds. In view of these facts, it is no wonder that bicycle accidents are often very serious.

The tractive force required to propel a bicycle over a smooth level surface is estimated at 0·01 of the load; calling the load 150 pounds, a force of 1½ pounds would be required to move the wheel forward, and this calls for a pressure on the pedals of 6¾ pounds on a wheel geared in the usual manner. When, however, the road is rough or on an up grade, the case is different. On a grade of 1 in 10, for example, the rider, in addition to the tractive force, actually lifts $\frac{1}{10}$ of his weight and that of the machine.

With a rigid or semi-rigid tire the rider is obliged to exert sufficient force to lift himself over every obstruction encountered by the wheel; the descent from the obstruction gives back a portion of the power expended in surmounting it, but not all of it. In the case of the pneumatic tire, however, the small obstructions are not an opposing element of any consequence, as the tire yields, in lieu of the wheel being raised, and the result is the wheel travels as upon a smooth track.

NEW PRIZES FOR MOTOR CARRIAGE COMPETITIONS.

In the belief that the invention and perfection of the vehicle motor is destined to work a revolution in road transportation, and with a view of stimulating invention along that line, the proprietors of two papers, one in America and the other in England, have offered substantial cash prizes to be given to the winners in two new races. In America the Chicago Times-Herald offers $5,000 to be awarded in a race between Milwaukee and Chicago; and in England the Engineer offers one thousand guineas ($5,000) to the winners in a race to be held in some place in England, which will be decided upon later. The Times-Herald contest will take place about the 1st of November and definite details as to the exact date of the contest, with such regulations concerning it as may be decided upon, will be soon announced. The first prize will be $2,000 and a gold medal, the same being open to the competition of the world; second prize $1,500, with a stipulation that in the event of the first prize being awarded to a vehicle of foreign invention or manufacture this prize shall go to the most successful American competitor; third prize, $1,000; fourth prize, $500. The third and fourth prizes are open to all competitors, both foreign and American.

Over twenty-one American inventors have already notified the Times-Herald of their intention of competing. The present indications are that there will be not less than fifty and possibly double that number of vehicles entered in this race. It is too early to state how many French and German manufacturers will enter the lists, but it is probable some of the prize winners in the recent Paris Bordeaux contest will endeavor to gain additional prizes. It is likely that the Daimler motor, which has proved so successful in both of the competitions held in France, will be used on several of the carriages. The offer of the Times-Herald is made with no intention of starting a "horseless carriage fad" or of promoting a craze in this direction, but it is the opinion of the best mechanical experts that the inventive genius of the world is in a fair way to solve the problem of propulsion on common roads by mechanical means, if it is not already solved. America is a country of magnificent distances, and its resources can never be utilized to the greatest advantage until the mechanical genius of the country has brought transportation to its highest possible development.

For some time past the Engineer, of London, has urged the repeal of such provisions of the existing acts of Parliament as prevent the use of light vehicles propelled by steam or other power on the public roads of the United Kingdom. On July 20, Mr. Shaw-Lefevre introduced the bill in the House of Commons designed to facilitate the introduction of horseless carriages in England, and when he explained the matter, not a single member objected, which was the more remarkable, considering how hard it usually is to overcome British conservatism.

The Engineer believes that the introduction of the automobile carriage into England would throw open a new branch of trade, so that the start which Continental engineers have made may not be allowed to interfere unduly with the home industries of Great Britain. They have, therefore, offered the sum of 1,000 guineas in two or more prizes for public competition upon one of the main roads of the kingdom. The rules and details of the competition and the names of the gentlemen who have consented to act as judges will be given out at an early date, and will be duly announced in these columns.

The carriages driven by petroleum now cost a cent or one and one-half cents an hour per horse power to drive them, so that even for a long journey the cost for fuel is not very great. The first cost of an automobile carriage is about $1,000, not much more than a good carriage. Hardly any one would care to run a machine carriage more than ten hours a day, the cost being 50 cents a day for fuel or $15 per month. Under favorable circumstances a good horse cannot be kept in a large city like New York or Chicago for less than about $30 to $35 per month. Because motor vehicles for common roads are practicable in France and England, it does not necessarily follow that they would be in America. The roads in those countries are almost perfection; but in this country a fairly good road is the exception, i. e., roads that are good the year round. Between the mud of the rainy season and the roughness when this mud is frozen, there are long periods of time when the petroleum carriage would have great difficulty in transporting passengers or freight.

ATLANTA EXPOSITION NOTES.

The work of construction at the Cotton States and International Exposition is rapidly approaching completion. Several of the buildings have been finished and accepted by the Exposition managers. The work of installation in the Electrical building has already begun, and the Machinery building is ready for exhibitors. The parking is almost finished and the grounds and buildings are beginning to resemble the completed Fair. The water from the city water works has been turned into the lake.

Dr. Daniel C. Gilman, president of Johns Hopkins University, has accepted the position of chief of the Department of Awards at the Exposition. This should be a guarantee of the high merit upon which the awards will be based.

The General Council of Philadelphia has decided to send the Liberty Bell to Atlanta. The request was refused at first, but the permission was granted after the Legislature of Pennsylvania decided to make a State exhibit.

The electric fountain at the Exposition is being constructed under the direction of the designer, Mr. Luther Stieringer. The design is that of a twin fountain, rising from an island in the center of the grand basin, immediately in front of the Machinery Hall.

The island which forms the groundwork for the base

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of the fountain covers the operating chamber, which is 100 feet long and 50 feet wide. There are 19 orifices, each with 7 to 10 jets; the electric lights used under each orifice to project the beam of light through the water are of 250,000 candle power each. The forms of water used are the solid stream, the geyser, the spray and the fog bank. The highest jets will rise something over 100 feet from the basin of the lake. The fog bank is to be produced by steam condensed by means of spray. The four forms will be used alternately in various ways with fine effect. The streams and geysers will be interspersed with circular pipes throwing jets in the form of wheat sheaves.

A party of newspaper men and ladies have arranged a house boat party to leave New York on the 1st of September for the Exposition. The route which they will take is a good illustration of the facilities for water travel through the United States. The route as outlined will traverse the Hudson River from New York to Albany, thence by the Erie Canal to Buffalo, thence to Cleveland, along the shore of Lake Erie, then to Portsmouth, Ohio, by the Ohio Canal, where the Ohio River will be taken to the Mississippi, and the latter down to some convenient point, probably Memphis, from which the railroad will be taken to Atlanta.

LEATHER CANNON.

On another page we give illustrations and an account of the recent trial by the United States Ordnance Board of Latulip's rawhide cannon, which, at first glance, might seem to be a decided novelty. But it is a curious fact that leather cannons were among the earliest powder weapons used. Rawhide, however, has advantages over leather for this purpose. The following is from Farrow's Military Encyclopædia:

"A variety of cannon introduced by Gustavus Adolphus into the army, on account of their mobility. Undeniable evidence, however, of their earlier existence, though of a smaller size, is found in the Landeshuter Harnisch-Kammer-Inventarium, of 1562, in which mention is made of a "Lange lederne Buchse mit Kugel-Modell." Although Gustavus Adolphus improved and perfected the leather cannon which he introduced into his army in 1626, and which he used in the siege of Wormditt, yet neither he nor the German Freiherr Melchior von Wurmbrandt, nor the North British Baron Robert Scot, can be regarded as the inventor. The invention is evidently of much earlier date. A leather mortar for firing shells, on exhibition in the arsenal at Venice, was, the Venetians assert, made in 1349; it is very likely, however, that its origin is somewhat earlier. One is here reminded of the many substitutes for metal ordnance, especially of the wooden cannon entirely bounded with iron hoops, which are frequently mentioned in the period from 1525 to 1530.

The leather cannon varied from a 1-pounder to a 4-pounder. The bore consisted of a copper cylinder, of the thickness of three fourths of the diameter of the ball used. The length of the cylinder was 16 calibers. Cascable and breech were screwed into the cylinder. The vent of copper was screwed into the breech. The entire length of the bore was covered with iron hoops, over which a number of ropes were wound, which in turn were covered with several layers of varnish. Over these layers another round of ropes was wound, and over this was spread a layer of cement. This process was repeated until the coat was of the thickness of two calibers. The last coating consisted of tarred leather, which gave the cannon its name. The charge amounted to one-fourth, rarely one-third of the weight of the ball; the cannon was loaded only with canister.

Canister shot, until that time only used in sieges, was introduced by Gustavus Adolphus into the field service and consisted mostly of musket bullets, though old pieces of iron were very often used. The shot were put into wooden and tin boxes, linen bags, and sometimes only in rude wicker baskets. The leather cannon of ninety pounds weight, with its light carriage, was easily drawn by two men. This cannon, however, by no means met the high expectations entertained of it. Already in 1631 the Swedes ceased using this nature of gun, because at the battle of Brietenfeld it not only became so overheated that the charges ignited of themselves, but it also gave a very short and unreliable range. In 1629, a certain Lieutenant Wolf Muller, of Chemnitz, circulated the report that he was in possession of a se ret for the construction of leather cannon which had many and decided advantages over metal ordnance. The Elector of Saxony ordered Col. Von Schwalbach to investigate and to report as to its worth. The report of the colonel was found to be favorable, and expressed in these words: "Owing to their light weight, easy transportation, and saving of powder, as well as the advantages they offer in the field against the enemy and in mountainous and swampy regions, in which latter places heavy cannon can seldom be used at all, such pieces cannot be too highly regarded," etc.

The Elector ordered the construction of two leather cannon, for which were given "fifty-seven florins three groschen, ready money, seventeen florins three groschen for sixty pounds pewter; fifty-one florins three groschen for two and one-fourth hundredweight refined copper. Of the copper, the coppersmith received two hundredweight, with which he made a tube four and one-half ells long, weighing ninety pounds, and used twelve pounds for muzzle and vent. The waste in melting twice amounted to sixteen pounds, the remainder was left to the smith as pay for his work."

The trial with these leather guns could not have been very satisfactory, if we may judge from the following item of a record of weights of the armory at Dresden, June 14, 1630:

"Inventory of the weights of copper and pewter of the burst leather pieces in the Elector's Armory at Dresden: Copper, one-half hundredweight twenty-six pounds; pewter, thirty-four pounds." No mention being made of these guns at a later period, it is taken for granted that this one failure was thought sufficient to cool all enthusiasm for leather cannon."

THE HEAVENS IN AUGUST.

The chief celestial event for August is the attainment by Venus of her greatest brilliance on the night of the 13th, or more strictly speaking, the morning of the 14th; yet this can hardly be called an event, either, since it is a part of a continuous phenomenon, Venus having gained gradually in light ever since she became an evening star, early in the year. And although from the 14th she will begin to lose light, yet the loss will not become conspicuous until near the end of the month. Now is the time for all possessors of good telescopes and good eyes to study Venus; for the possibility exists of making an important discovery concerning that planet. Some weeks ago the cable brought from Europe the news that a curious notch had been detected at the Vienna observatory near the south horn of Venus and observers in this country were advised to look for the phenomenon, and note its peculiarities. The meaning of this is that Venus, which now appears in the form of a crescent moon, has on the inner, or concave, edge of the crescent, near the southern end, a narrow scallop as if a bit of the face of the planet had been cut out there. The phenomenon is not a new one. It has been seen many times before, and, reasoning on the basis of what plainly appears on the moon in similar circumstances, it would seem that this notch in Venus may be caused by the shadow of a gigantic mountain mass in the Antarctic region of the planet. The importance of a careful study of this and other faint markings on Venus depends not merely upon the information it may give concerning the surface features of that interesting globe, but also upon the bearing it may have on the question of the rotation period of Venus.

Schiaparelli has asserted that the rotation of Venus is very slow and that probably it turns but once on its axis while making a revolution around the sun. It is easy to see that, if such is the case, Venus possesses no alternation of day and night, such as we enjoy on the earth, but that, on the contrary, it is always day on one side of the planet and always night on the other side. And the orbit of Venus departs so slightly from a circle, and her axis is apparently so nearly perpendicular to the plane of the orbit, that there can be very little libration, in either latitude or longitude, to affect the presentation of the planet's surface toward the sun.

Now it must be confessed that, without drawing freely upon the imagination, it is not easy to reconcile such a state of things as that just described with the conditions which would seem to be necessary in order to render a planet habitable by beings resembling ourselves. Of course, perpetual sunshine might not prove destructive to highly organized living forms, for they could, in various ways, be shielded from the effects of such a superabundance of radiant energy, and, on the other hand, life might exist where the only radiation received came from the stars. But, as I have remarked in a preceding article, Venus is so much like the earth in several other respects, that one would prefer not to believe she is so much unlike it in this, unless the evidence of the peculiarity ascribed to her by the Italian astronomer can be shown to be irrefragable. It is very much to be desired, therefore, that the present opportunity shall be fully utilized to add as greatly as possible to our knowledge of the markings and the motions of Venus.

At the beginning of the month Venus is in the southern portion of Leo, and before the end she will have passed into Virgo. Everybody, of course, knows where to look for her—in the west after sundown; and nobody will have to look twice to find her, but anybody who can see her once and not look again is fitter to be despised than that imaginary creature of Shakespeare, "who hath no music in himself."

Next to Venus, Saturn is the most conspicuous planet now on view, and I repeat my advice to everybody who can get the opportunity to take a good look at its marvelous rings. One might travel to the confines of the universe without finding anywhere an exact duplicate of them. To see them with an adequate telescope is to become on the instant an astronomer, if spirit if not in practice.

Saturn remains some ten degrees east of Spica, the bright star of Virgo. By the end of the month it will set too early to be advantageously studied with a telescope.

Mercury, Mars and Neptune are too near the sun for observation. Jupiter begins to emerge from the sunlight as a morning star early in the month, but will not be well seen before the autumn months. Uranus remains in Libra a few degrees east of the star Alpha.

The moon fulls on the morning of August 5 in the constellation Capricornus, and reaches last quarter near noon on the 13th in Aries. Beginning its circuit again as new moon on the morning of the 20th in Leo, it attains first quarter on the 27th, about a quarter before 1 A. M., in Scorpio. It is in perigee on the 20th and in apogee on the 7th. A partial eclipse of the sun occurs on the morning of the 20th, but will not be visible in this country.

It will be observed that the moon is in perigee, or nearest to the earth, on the day of the eclipse, when, of course, it will be just in a line from the earth to the sun. Under such circumstances not only is the moon's tidal attraction greatest, but its attraction is at the same time united with that of the sun. The consequence must be higher tides than usual; while those who believe that the varying strain of the sun's and the moon's tidal pull on the earth is an element in the production of earthquakes should expect unusual phenomena of that kind about the time of the eclipse.

The moon will be seen near Venus on the evening of the 22d, near Saturn on the evening of the 24th and near Uranus on the evening of the 25th.

GARRETT P. SERVISS.

Cycle Notes.

The greatest achievement of the bicycle of late was the covering of 515 miles within twenty-four hours, which was done by a Frenchman named Huret. It is well known that but few horses have been able to go 100 miles in this time. But it is not the exceptional speed or endurance of phenomenal riders which makes the bicycle the most popular invention of this or any other time. There is a charm, a degree of freedom, a power, belonging to the bicycle which only those who ride it comprehend.

Amos Holmes, of Unadilla, N. Y., 94 years of age, claims to be the oldest bicycle rider in New York State.

One of our correspondents, who is now taking a cycle tour through France, reports that the French and English wheels are heavier and more clumsy than the American vehicles. A first-class wheel, such as Americans use, is not to be had in Europe. Our correspondent regrets he did not take his Yankee wheel with him.

Bike Don'ts.—A writer in the New York Sun gives the following:

Don't be down on everbody else's wheel except your own.

Don't go back and apologize when you knock a man or woman off their pins. You may mean well, but you will find the person knocked down unreasonable and sometimes impertinent.

Don't ride over railway crossings. Don't try to instruct others unless you know a good deal about riding yourself. Don't laugh at beginners, but remember that we've all been there ourselves, and don't get dissatisfied with your own wheel because some one has a machine that is a little better.

Don't lend your wheel unless you do it to get rid of the borrower, and you may feel pretty sure that you get rid of your wheel at the same time, for it always injures a bicycle to lend it.

Don't allow your wheel to remain in a dirty condition for even a very short time.

DECISIONS RELATING TO PATENTS.

United States Circuit Court of Appeals — Seventh Circuit.

RUSSELL VS. KERN.

Letters Patent Nos. 133,898, 137,495, 154,770 and 158,992, to George T. Smith, for middlings purifiers, having expired prior to the commencement of the suit, afford no basis for equitable relief.

Letters Patent No. 164,050, granted June 1, 1875, to George T. Smith, for middlings purifier, having expired after the filing of the original bill, but before the return day of the subpœna, it was within the discretion of the court to dismiss the bill for want of equity.

Letters Patent No. 187,923, granted February 27, 1877; No. 194,539, August 28. 1877; No. 208,936, October 15, 1878; No. 236,101, December 28, 1880, and No. 258,142, May 16, 1882, to George T. Smith, for middlings purifiers, Held invalid as being for indivisible inventions covered by earlier patents to the same party.

Appeal from the Circuit Court of the United States for the Eastern District of Wisconsin.

Before Woods, Jenkins, and Showalter, judges.

Woods, C. J., delivered the opinion of the court.

Bill dismissed.

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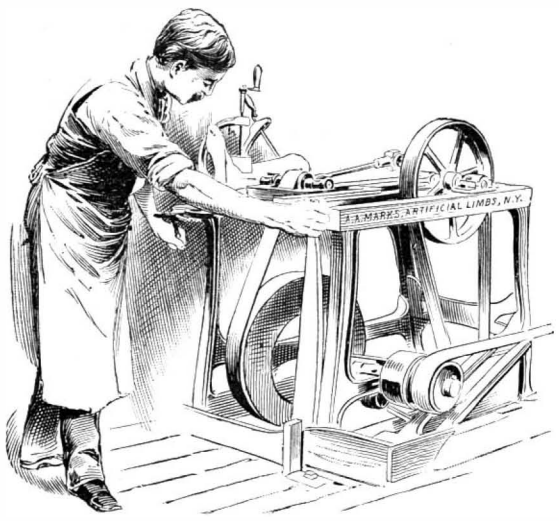
THE MANUFACTURE OF ARTIFICIAL LIMBS.

(Continued from first page.)

directly thereto. This makes an absolutely waterproof leg, which is adapted to those whose occupations expose them to wetting.

The knee joints are made in several ways, whose details cannot well be gone into here. The operation of setting up the leg and connecting the knee joints is shown in Fig. 3. These joints have been, in some



MORTISING.

cases, constructed on principles adapted to the ideas of the wearers, where such seemed good practice. The elasticity of the foot, due to the depth of sponge rubber at the heel and to the long rubber toe, takes the place of the ankle joint.

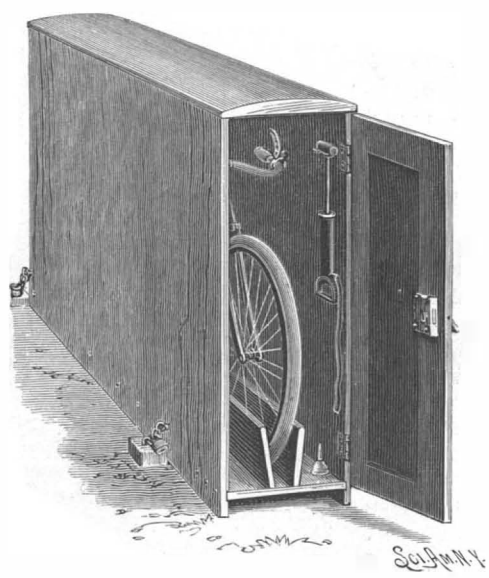
Artificial arms are made in the same way. India rubber hands are used instead of the old wooden ones. Sometimes a hand with malleable wire finger cores is employed. Holes are bored in the wooden core of the hand into which the doubled ends of bundles of wire (Fig. 6, k) are inserted and pinned; h shows the hand thus far advanced. Tape wrapping is then applied until the fingers reach the proper size, as shown in i, when all is ready for the coating of India rubber. This hand can have its fingers bent so that it can hold a pen or other light instrument. In Fig. 6 f are shown a knife and brush adapted to be inserted in a socket in the hand. The small projecting handle is used to insert them with.

The beneficent results of this work have been mentioned. In the Marks factory is a workman with two wooden legs. He does a full day's work standing at his bench, and then will often play billiards all the evening. It is impossible to believe that he depends altogether on artificial limbs. Tight rope walking, hurdle jumping and other apparently impossible feats are performed by wearers of the Marks limbs. As a mechanical process the operation of wooden leg making is most interesting, and the limits of this article preclude a full description.

The noise of machinery, the humming of wheels, the buzzing of saws and the many men stationed at their benches show that the industry is of far greater magnitude than any one would suppose. There are over forty employes in this establishment, and the capacity represents an output larger than the aggregate of any other ten artificial limb factories in the world.

A CASE TO HOLD A BICYCLE.

To obviate the inconvenience of moving a bicycle into or out of the house whenever the machine is used,



MUMFORD'S BICYCLE CASE.

the case for holding the wheel shown in the accompanying illustration has been patented by Mr. Norman W. Mumford, of Santa Barbara, Cal., the case being adapted to be securely locked to a building, post or other fixture. It is a closed box-like structure, with bottom raised to protect it from moisture and has at its ends handles to facilitate moving it about. In its bottom are parallel guides, whose inner ends incline upward, so that when the machine is pushed back into the case, the rear wheel will fit snugly between the higher portions of the guides. Nearly opposite the handle bar, at the top and sides, are straps by which the machine may be held so as not to move in the case.

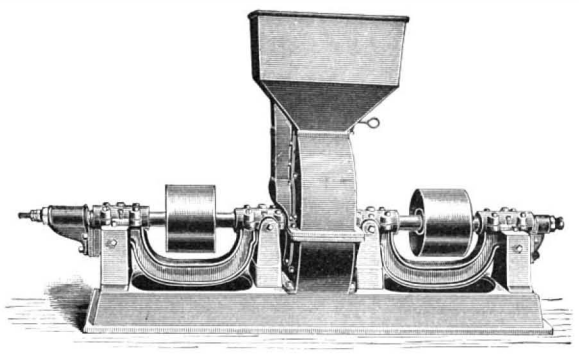
Mishap to the Columbia.

On July 13 the U. S. cruiser Columbia, while being dry-docked at Southampton, England, was strained, owing to the placing of the keel blocks of the dock too far apart, which caused the keel plates of the vessel to be dented in and the cement between them and the inner hull to be cracked. The ship was further damaged by the bending of several frame stanchions. Recent reports from the Navy Department at Washington say that about $5,000 will be the cost of repair, and also that a court of inquiry will probably be instituted for fixing the responsibility in the matter. The Columbia was dry-docked at Secretary Herbert's orders, so that she might be put in condition for a trip against time across the Atlantic, and it is not thought the damage is serious enough to prevent this or participation in the coming squadron maneuvers.

The mishap to the Columbia appears to have been the result of gross carelessness somewhere. It seems almost incredible that the dock people should not have known how to block the ship properly. We presume the arrangement of the blocking was not examined by the officers of the vessel before the docking; they no doubt took it for granted that everything was arranged in the best possible manner.

AN IRON GRINDING MILL OF LARGE CAPACITY.

The illustration represents a mill of approved excellence, especially adapted for grinding corn, oats, spices, oil cake, cocoanut shell, glue, sugar, etc. It is manufactured by Munson Brothers, Utica, N. Y. The grinders comprise two disks mounted on steel shafts, and running at a high speed in opposite directions, there being fastened to the disks hard metal grind-



THE ROBINSON GRINDING MILL.

ing plates which require no sharpening and which will wear from six to twelve months. When worn out they are replaced at small cost. The mill requires no special foundation, and can be driven by belts from above, below or diagonally. The mill is easy to adjust, and the journals are connected by yoke and are self-oiling. It does not require skilled labor to operate the mill, and its capacity is from 60 to 100 bushels per hour. It occupies a floor space of 6 feet 8 inches by 2 feet 4 inches over all, and is run with 20 to 25 horse power.

Typography a Roman Art.

It is stated on the authority of the Foia Diecessana, the official paper of the Greek-Rouman bishopric of Carausebes, in South Hungary, that unmistakable evidence of the art of typography has been discovered among the ruins of Bersovia, in Dacia, an old province established as a colony by the victorious Romans on territory then acquired by them. The discovery is attributed to the architect and archæologist Adrian Diaconu, who, it is said, found evidence of the use even of movable type by the Romans at this colony, and particularly by those of the fourth legion, Flavia Felix. Two members of the Bucharest Scientific Academy confirm Diaconu's opinion, having examined the evidence and declared the discovery to be of the utmost importance.

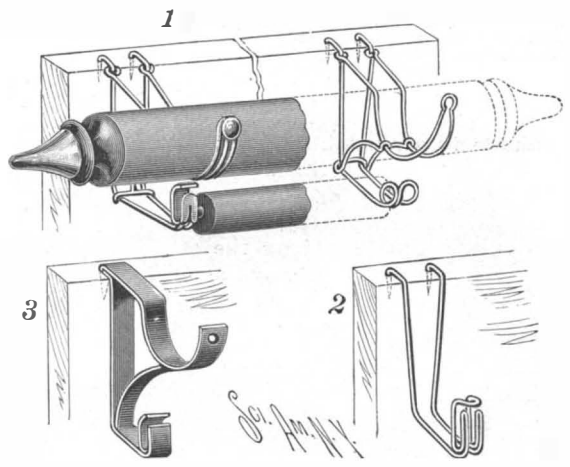
If these facts be really true, the honor of inventing typography will no longer reside with the Germans nor with the Italians, who attributed the discovery to Panfilio Castaldi.

A Northern Scientific Expedition.

The steamer Portia sailed from Brooklyn June 22 carrying an expedition under Emil Diebitsch which will proceed to Lieut. Peary's headquarters in North Greenland and will bring him and his small party of explorers home. The relief party is composed of Prof. Rollin D. Salsbury, of Chicago University, Theodore Le Boutillier, of Philadelphia, John E. Walsh, of Washington, and Prof. L. L. Dyche, of the Kansas State University.

A BRACKET SUPPORT FOR SHADES, CURTAINS, ETC.

A very simple and convenient bracket, readily attachable to a window or door frame, is represented in the accompanying illustration, and has been patented by Mr. Charles Pettit, of No. 3005 South C Street, Tacoma, Washington. Fig. 1 shows the bracket in position for the support of a curtain pole and a shade roller, Figs. 2 and 3 representing modified forms of the improvement. As shown in the first figure, the bracket is formed of bent wire, terminating in pins at its upper end adapted to be driven into the top of the window



PETTIT'S CURTAIN BRACKET.

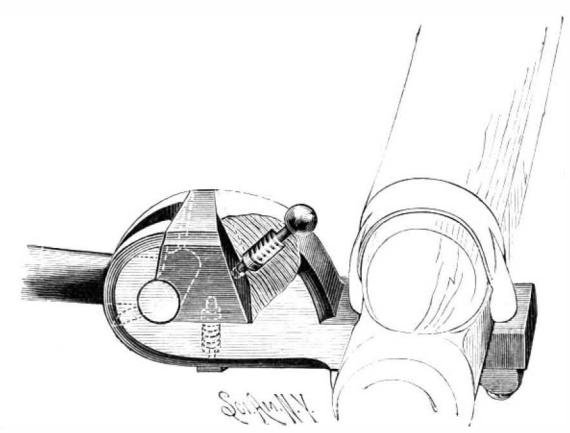
or door frame, an auxiliary bracket for the support of the curtain pole being held on the first bracket, and having at its outer end an eye in which a thumbscrew may be inserted. In Fig. 3 the bracket is shown formed of sheet metal, and the flat arm at its upper end has an angular extension with teeth adapted to be driven into the top edge of the support. Other variations of the form of the bracket are set forth in the patent.

Animal Humbugs.

In military stables horses are known to have pretended to be lame in order to avoid going to a military exercise. A chimpanzee had been fed on cake when sick; after his recovery he often feigned coughing in order to procure dainties. The cuckoo, as is well known, lays its eggs in another bird's nest, and to make the deception surer it takes away one of the other bird's eggs. Animals are conscious of their deceit, as shown by the fact that they try to act secretly and noiselessly; they show a sense of guilt if detected; they take precautions in advance to avoid discovery; in some cases they manifest regret and repentance. Thus, bees which steal hesitate often before and after their exploits, as if they feared punishment. A naturalist describes how his monkey committed theft. While he pretended to sleep the animal regarded him with hesitation, and stopped every time his master moved or seemed on the point of awakening. — Public Opinion.

AN IMPROVED THILL COUPLING.

In this coupling the thill or pole iron is so held that it cannot leave the coupling unless purposely removed, the thill irons being readily placed in coupling position or removed. The improvement has been patented by Mr. William H. Byrne, of Piedmont, Wyoming. The body of the coupling has extending through from side to side a horizontal wedge-shaped recess with undercut side walls, and in the bottom of its forward wall is an auxiliary semicircular recess. A wedge-shaped block adapted to fit into this space has a semicircular recess registering with the auxiliary recess in the body of the coupling, the head of the thill iron being held in the space afforded by the two recesses, and its shank having free movement in a vertical recess in the front of the body of the coupling. The block is held from



BYRNE'S THILL COUPLING.

lateral movement by spring-pressed bolts, at the bottom and back, and to prevent rattling a packing of rubber may be placed on the head of the thill iron, to be held in place by the block or by a thin iron fitting the back end of the shaft, and with each end turned back over the block.

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IMPROVED REPEATING PISTOL.

We have described at various times automatic military arms, like the Maxim gun, automatic rifles to be used from the shoulder, like the Rees magazine rifle, and now comes an automatic pistol, which extracts the cartridge case, inserts a new cartridge and compresses the striker spring, by the force of the recoil. Of course, it cannot be kept in action for an indefinite period, like the Maxim gun, as the supply of cartridges is limited to eight. Up to this number, however, it can be fired as fast as the trigger can be pulled, and that without the disturbing effect that arises in a revolver from the exertion of having to rotate the chambers and compress the spring each time.

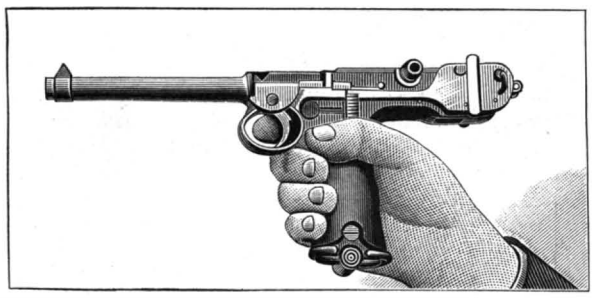

FIG. 1.

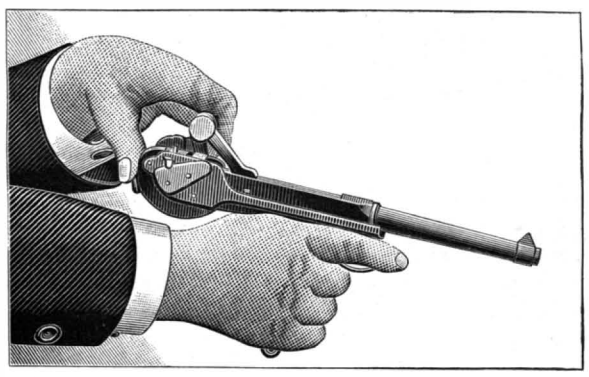

FIG. 2.

THE BORCHARDT REPEATING PISTOL.

The Borchardt repeating pistol is manufactured by Messrs. Ludwig Loewe & Company of Berlin. As shown by the illustrations, it departs considerably from the usual form of such a weapon, the stock being continued backward to provide for the repeating mechanism. The cartridges are contained in the grip, and as they are fired there is no perceptible difference in the balance of the weapon. The barrel (Figs. 1, 2, and 11) is of considerable length, and is capable of sliding in guides in the grip 3 (Figs. 4 and 11), together with the receiver 34 (Fig. 11). The breech block 41 is guided in the receiver by means of two ribs, and is held up firm against the force of the explosion of the charge by means of two links 47 and 49 (Figs. 4, 7, and 11), which at the time of firing are in line. The link 47 is pivoted to the breech block, and the link 49 to the receiver. When a cartridge is fired, the barrel is forced backward by the recoil, the receiver, the breech block, and the two links all moving together, the parts being in the positions shown in Figs. 3 to 5. But after a very short motion the roller 52 (Figs. 4, 7, and 11) strikes the curved path 19, whereupon the two links are brought into the toggle joint position shown in Fig. 9, and the breech block 41 is drawn clear back from the barrel. In going back it takes the empty shell with it, by means of the extractor, until the shell strikes the ejector 14 and is thrown out. The top cartridge in the magazine is held by the feeding spring 68 to 71 (Figs. 10 and 11), ready to be inserted into the chamber on the return of the breech piece. The lips at the mouth of the magazine allow the base of the top cartridge to project a little into the path of the breech block, whose return is effected by the springs 31 and 17. The former is fixed to a pin in the grip at one end, and is pivoted to the link 49 at the other end (Fig. 8), while the spring 17 limits the movement of the link 49. The effect of these two springs is to move the parts from the position shown in Fig. 7 to that in Fig. 8, immediately the back stroke is completed.

We have thus seen how the breech is opened, the empty shell extracted, a fresh cartridge put in position and driven into the chamber, and the breech closed. It remains to be seen how the striker spring is compressed and the lock cocked. The front end of the forward link 47 has, on the left side, a projecting nose, which draws back the firing bolt as soon as the opening of the breech takes place. The firing bolt 43 (Fig. 3) is a hollow cylinder, with a projecting lug on one side, and a spiral spring 44 (Fig. 8) in its interior. This spring takes against the screw plug 42 which closes the rear opening of the breech block. The lug on the firing bolt is engaged by the nose of the sear 35. The trigger 10 moves in a circular groove in the side and forward of the grip. When it is pulled, the wedge-shaped end presses the front arm of the sear inward, and raises the nose of the sear arm sufficiently to release the firing bolt.

The movement of the breech block and links is so rapid that the finger cannot release the trigger before they have reloaded the pistol. There is, therefore, a special contrivance to prevent the whole eight cartridges being fired off in a second or so. In order that the sear may not strike solid against the still raised wedge-shaped end of the trigger, a yielding pin 39 is fitted into the forward end of the sear. This pin rests on the spiral spring 40, and recedes when it strikes against the trigger, and after the trigger has been released, snaps forward behind the wedge-shaped end of the latter, so that the firing can be repeated.

The cartridges, eight in number, are contained within a case 61 to 67, which is pushed up into the hollow grip, and snapped there by the spring 8. This case can be withdrawn at any time to see how many remain. Spare cases can, of course, be carried to expedite the loading in the heat of battle. The spring 8 also secures the "safety" 7 in both positions. This latter is fitted into vertical grooves in the side of the grip. When pushed upward by the thumb, it locks the sear and trigger, and prevents every motion of the mechanism.

Fig. 2 shows the method of introducing the first cartridge into the chamber. The grip is held in the right hand, and the knob on the link 49 drawn back by the left hand until the breech block is past the base of the top cartridge. The breech block is then allowed to return, pushing the cartridge before it. The pistol is now loaded and cocked, and if it is not to be fired immediately, the "safety" must be pushed upward to prevent accident. For our illustrations and the foregoing particulars we are indebted to Engineering.

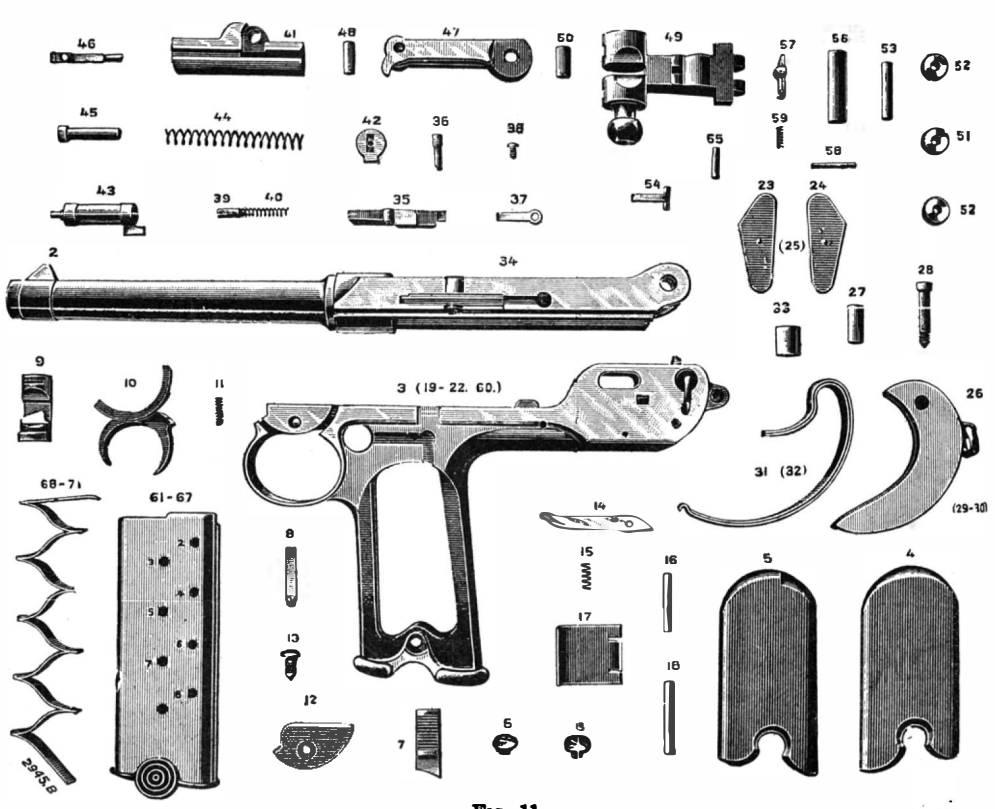

FIG. 11.

THE BORCHARDT REPEATING PISTOL.

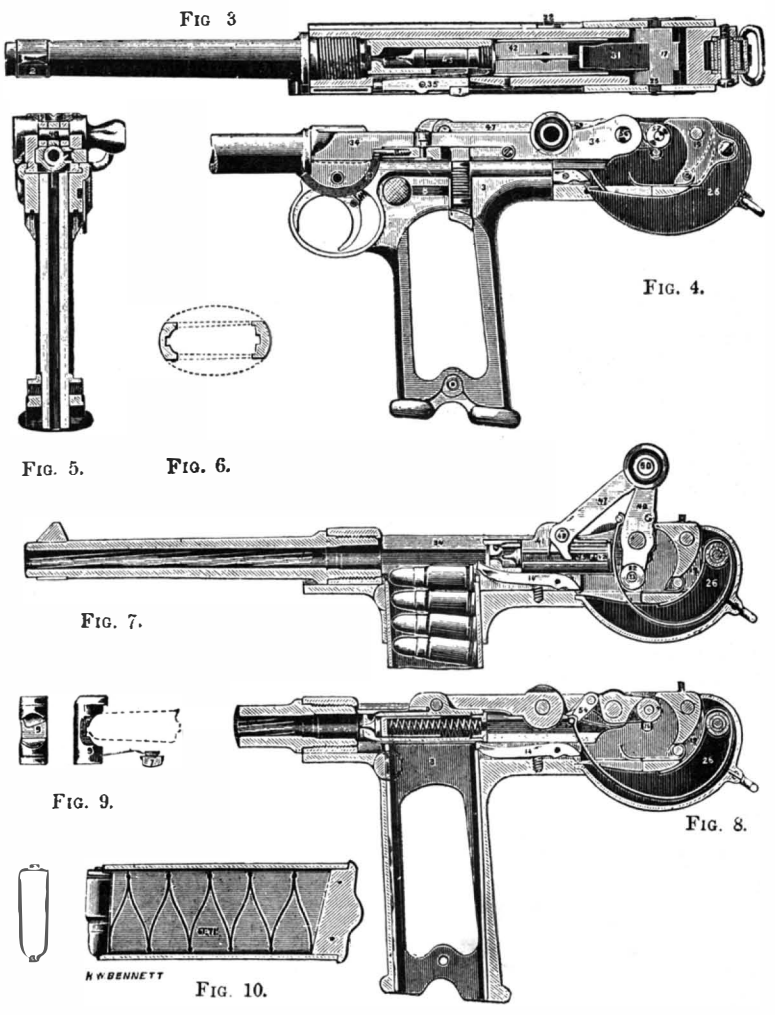

FIG 3

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 9.

FIG. 8.

FIG. 10.

THE BORCHARDT REPEATING PISTOL.

The Elm Leaf Beetle in New England.

The advance of the elm leaf beetle into New England has been extremely rapid. When attention was first called to their probable advent a month ago, the entomologists had not evidence that there was one in New England, but they had probably then begun their visitations, and about a fortnight ago they were reported in full force in several towns in Connecticut and western Massachusetts. Stamford, Milford, Bridgeport, and other towns along Long Island Sound have been ravaged, and from New Haven they have come up the valley, and are in Hartford as well as in this city. The damage done in the famous elms of New Haven, the Elm City, is melancholy to contemplate. The trees are as brown as in the last of fall, and no work has as yet been done to stop the despoilment Last week the city council determined to take measures against the pest. Most of the mischief for this year had been done, and that will be the case almost everywhere, though perhaps in this city we may have begun in time to save most of our trees. A few weeks ago the State Agricultural School at Mansfield, Conn., published full directions for the meeting of the elm leaf beetle at the outset. Prof. C. D. Woods said:

"The easiest way to destroy the beetles and prevent to a considerable extent their ravages another season is to treat the ground around the base of the trees for a distance of several yards with strong kerosene emulsion. This will not help the trees this season, but if all the pupæ at the surface of the ground are destroyed, and if this is done under all the trees in a given town, there will be no beetles to lay eggs next season.

"Unless pupæ are destroyed now the only way to protect the elms next year will be by the expensive and somewhat difficult method of spraying with Paris green or London purple. The kerosene emulsion is best prepared in this way: Soft soap, one quart; kerosene, one pint; water, six quarts. Warm the soap until it becomes liquefied. Remove from near fire, add the kerosene, and agitate rapidly with a force pump for five to ten minutes until it becomes a homogeneous creamy mass from which the kerosene will not separate on standing. Add the water and thoroughly mix, when the emulsion will have the appearance of milk. This should be applied near the trees at two or three different times in sufficient quantities to thoroughly saturate the surface of the ground. A force pump with spraying nozzle or a watering pot with rose can be used to apply the emulsion."

The Elm City authorities began their tardy work Saturday by pumping the kerosene emulsion into the tops of the elms.

In many places in Massachusetts the old protection against the canker worm is brought into play, the same which was used a score or more years ago all over Boston, every tree on the Common being then belted with tin bands, drawn taut about the tree trunks with their projecting, crumpled edges bent downward, and a gutter kept filled with kerosene to receive the larvæ as they crawl up.—Springfield Republican, July 22.

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Correspondence.

Safety Devices Wanted.

To the Editor of the SCIENTIFIC AMERICAN:

The loss of life from runaway accidents in this country mounts up to the hundreds yearly, so that very many people, especially women, fear to ride or drive. The best of horses are timid among steam cars, trolley lines, bicycles, and the thousand and one things one meets nowadays on our roads. Cannot some of your inventors design a safety brake that will stop the crazy beast, or a device to detach him from the vehicle and let him go headlong by himself, or blinders to blind him, or a throat latch to choke him?

There is money, and a good deal of it, to be made by a good, effective device of some kind for this purpose.

WM. H. HIGBEE.

New York, July 19, 1895.

Science Notes.

Molybdenum.—Mr. Moissan recently reported the results of his researches on molybdenum to the French Academy of Sciences. He fused the metal easily and in great purity in the electric furnace. Its density is 9. It is a metal as malleable as iron, is easily filed and polished, can be forged when heated, and scratches neither glass nor quartz. Being very free from carbon and silicon, it does not oxidize in air unless at a dull red heat, and can be preserved for days in water without chemical change. In the presence of air, it becomes covered with an iridescent film like steel. When heated with carbon, it forms a steel much harder than pure molybdenum. It will be useful in the purification of Bessemer steel as a substitute for manganese, since the compound, being volatile, will not mix with the slag.

Boiler Incrustation.—Mr. G. Lievin, says Le Genie Civil, has just pointed out to the Academy of Sciences the property that crude petroleum possesses of preventing incrustation in steam boilers. The Comptes Rendus publish merely the following extract from a study that evidently interests the Academy but slightly, and that might better have been submitted to the Society of Civil Engineers or the Society of Encouragement:

"We add a few cans of crude petroleum to our feed water, and never have had any new incrustations. The deposit of mud that sometimes forms in the boilers is expelled at the close of work through the mud cock at the bottom, when the pressure of the steam is not so strong."

Toxicity of the Fluorides.—There is no doubt, says the Pharmaceutische Centralhalle, that the fluorides will soon find extensive application both as preserving agents for food and as antiseptic medicines. Their progress seems only to be checked by the fears entertained of their poisonous nature. Experiments made with animals, however, show that they can take immense quantities of fluorides with perfect impunity, and, even after continued use, no poisonous effects result. Tappeiner finds that although sodium fluoride is more poisonous than other alkaline salts, it would be necessary for an animal of one thousand pounds weight to swallow at least one thousand liters (beer refuse?) per day before toxic effects would ensue. He estimates that a fatal dose would have to consist of 0·5 kilo. to each kilo. of body weight. Goats and dogs have also been experimented upon and given daily for three months from 0·3 to 0·5 gramme of sodium fluoride with their food without being any the worse for their experience. In the case of the former, the milk was even not in the least affected. The effects produced on human beings seem, however, much less favorable. Mr. A. G. Bloxam purposely consumed a piece of salmon which had been lying for three months in a five per cent solution of sodium fluoride. After eating, salivation set in at once, followed by sickness and diarrhœa, and in the night the circulation became very slow. He estimates that the quantity of sodium fluoride consumed amounted to about 5·5 grammes.

Musk.—The odor of musk is very widely diffused in nature, both in the vegetable and animal kingdoms. Of the former may be instanced the common musk plant Mimulus moschatus, Dougl.) and the seeds of the Abelmoschus moschatus, Medii, Hibiscus moschatus, Lin., which are employed by the French under the name of ambrette as a substitute for animal musk. In the animal kingdom there are several pervaded with the musky odor among insects, quadrupeds and reptiles; but for commercial purposes musk is solely obtained from the male of the musk deer (Moschus moschiferus).

This strong perfume is in demand all over the world. The Chinese have known it for many ages, bordering as their empire does on Thibet and Siberia. They call it che-kiang, "che" being the name of the animal, and "kiang" meaning perfume.

The musk deer lives in Thibet, Yunnan, Sze-tchuan, and more sparsely in Pielschi-li, or Chili, North China. Manchuria also furnishes it. The principal depot of the musk trade is the city of Tachien-lu, in about 30° north latitude, west of the province of Sza-chwan. Thibet and Annam are the principal musk-producing districts. Silungchan, in Kwangsi, and Wutingchan, in Yunnan, are probably the chief markets for the musk shipped from Canton.

Mr. R. Lydekker contributed a paper to the Journal of the Royal Asiatic Society of Bengal, in 1880, stating that the musk deer there was of common occurrence, and probably extended north of that district in most of the open countries up to Thibet, and thence across or round the Gobi desert into Siberia. There are two commercial kinds of musk, the Tonquin of Thibet, received chiefly from China, and the Cabardine or Siberian, from India. As the interior or Indian consumption is not taken into account, probably 20,000 deer are actually killed, male and female. In some adult males the pod will contain over 2 ounces, but an ounce may be taken as the usual average. Many of the deer killed when young will only average, all round, half an ounce. In most of the hill states of India, the musk deer is considered a royal property, and the rajahs keep men purposely to hunt it. The Cabardine musk, which is inferior to the Tonquin, is believed to be obtained from a species of musk deer called "Kubaya," probably Moschus Sibericus.

The Hydrogen Wall in Electrolysis.—To obtain a greater efficiency in the reduction of the highly electropositive metals, such as potassium, from aqueous solutions, Mr. L. Pyke, at the recent Royal Society soiree, showed the "hydrogen wall." He produced an amalgam of the metal under reduction by placing the mercury cathode in a porous vessel. The amalgam is in its richest condition at the top of the porous vessel, which is the part furthest removed from the liquid. The precise action of the device is said to be the prevention of the liberation of hydrogen at the electrolytic contact surface.

Electricity in the Bessemer Process.—What may turn out to be one of the greatest inventions of the age was recently tested at the Homestead Steel Works and proved very successful. It was the test of a plan for reheating steel by electricity under the Bessemer process. Steel men have tried to solve the problem of preventing the chilling, but all have failed. Mr. C. M. Schwab, manager of the Homestead plant, and Mr. A. C. Dinkey, head electrician, recently put their minds to work on a plan to obviate the difficulty by the use of electricity. A heat there was allowed to become somewhat "cold," and the electricity was introduced. The effect was startling. The molten steel, about twenty tons, that was lying dead in the ladle, immediately began to boil, and in a few minutes reached a white heat. The blaze ascended several feet above the ladle and was of blinding intensity. The steel was poured, but over a dozen workmen had their eyes burned badly.

Sources of Colors.—An interesting enumeration has been made by somebody and published in a technical journal of the sources of color. From this it appears that the cochineal insects furnish the gorgeous carmine, crimson, scarlet carmine and purple lakes; the cuttlefish gives sepia, that is, the inky fluid which the fish discharges in order to render the water opaque when attacked; the Indian yellow comes from the camel; ivory chips produce the ivory black and bone black; the exquisite Prussian blue comes from fusing horse hoofs and other refuse animal matter with impure potassium carbonate; various lakes are derived from roots, barks and gums; blue black comes from the charcoal of the vine stock; Turkey red is made from the madder plant, which grows in Hindostan; the yellow sap of a Siam tree produces gamboge; raw sienna is the natural earth from the neighborhood of Sienna, Italy; raw umber is an earth found near Umbria and burned; India ink is made from burned camphor; mastic is made from the gum of the mastic tree, which grows in the Grecian Archipelago: bister is the soot of wood ashes: very little real ultramarine obtained from the precious lapis lazuli, is found in the market: the Chinese white is zinc, scarlet is iodide of mercury, and vermilion is from the quicksilver ore cinnabar.

Armor Tests.

Orders have been sent to the Norfolk Navy Yard to prepare a section of the side of a ship, which, when completed, will be shipped to the Indian Head proving grounds, where a 14 in. ballistic plate, representing a group of armor for the sides of the battleship Iowa, will be fitted to it. This structure will be exactly similar to the section of the side of a vessel. It will be fired at with a 12 in. gun first, to try the armor for acceptance, and if the plate passes the ballistic test, it will be fired at with a 13 in. gun to obtain the effect such an impact will have on a vessel's side. Heretofore the knowledge of the department regarding the action of projectiles on ships sides has been largely theoretical, the actual experience being confined to the results obtained from the impact of projectiles on plates fitted to 36 in. of solid oak backing. Another interesting experiment will be made with armor plate bolts to ascertain whether or not it is feasible to shorten them. Bolts for heavy plates now weigh 150 lb. each and are troublesome and expensive to put in place. A bolt prepared by the Board, consisting of Naval Constructors Stahl and Capps and Professor Alger, is greatly reduced in length and weighs 50 lb. less than the larger size. The total weight saved on these bolts in fitting armor plate to a ship would average about 25 tons—a saving the authorities are anxious to make. Bolts of this size will be arranged at the Indian Head proving grounds to hold armor to backing and will be fired at. The result of this experiment will develop the size of bolt to be used in fitting armor on the new battleships.

The Sheathing of Iron Ships.

The most economical and durable method of sheathing ships to prevent fouling is a subject of great interest to all, and a most valuable contribution on the subject, from the experience of the Admiralty, has been communicated to the Institution of Naval Architects by Sir William White.

The only records available up to the present time have been those contributed by the late Mr. Grantham, in 1869, chiefly based upon experience gained with the composite ships of the mercantile marine. In the Royal Navy wood had been largely—indeed, chiefly—used in the construction of various classes of unarmored vessels. The information now given is essentially as regards the behavior of sheathing applied to complete iron or steel hulls, and as this has been practically outside mercantile experience, the procedure has been necessarily experimental in the navy to a large extent.

There has been considerable divergence of opinion as to the best metallic sheathing to be used on iron and steel ships. The advocates of copper and zinc respectively had each strong points to urge: galvanic action between iron and steel and copper, in which the former would be the sufferers, was feared, whereas it was pointed out that zinc in its relatively electrical position to iron and steel would practically protect the latter. Under the test of experience zinc, though protecting the iron and steel, has failed to recommend itself as a material that would maintain a clean bottom. The formation of insoluble salts on the zinc, by the action of the sea water, soon causes serious roughness on the bottom and tends to fouling.

On the whole the conclusion has been arrived at that the extra expense of external copper sheathing, as compared with zinc, is more than repaid on subsequent service by economy of coal and maintenance of speed. What remains then is to find the most durable and economical way of mounting such copper sheathing on iron or steel hulls, and to neutralize the tendency to destructive galvanic action upon the iron or steel. It was first attempted to produce these results by laying two skins of wood planking between the iron skin and the copper, the inner planking being attached by through bolts to the iron skin and the outer planking to the inner by brass screw bolts passing into, but not intended to pass through, the inner layer.

This arrangement has not, however, given satisfactory results so far as our navy is concerned, the planking having been permeated by the sea water and electrical continuity with corrosion having been set up. Sir William White, after full consideration, has laid down the principles of what he believes to be the most effective system as follows:

1. The adoption of such a thickness of single plank sheathing as will admit of thorough calking. The mean finished thickness of teak accepted is 4 inches for large ships and 3½ for the smaller classes. 2. The use of naval brass bolts and nuts with their points screwed through the skin plating and with thin plate washers fitted underneath the nuts. 3. The thorough water testing of the skin plating before planking is worked. 4. The most careful fitting of the planks, the coating of all faying surfaces with suitable compositions, and subsequent injection of composition after the planking is in place. 5. The use of hempen grommets steeped in red lead under bolt heads and plate washers.

Six years' experience has fairly shown that such a sheathing is satisfactory and practically watertight. The skin when so sheathed may be practically reduced in thickness as compared with an unsheathed hull, and the minimum of planking is required. In case of injury the single planking is easily and cheaply removed for repairs.

Careful observations in the Royal Navy in European waters have shown that after five or six months afloat unsheathed ships have required 20 to 25 per cent more power to maintain ordinary cruising speeds than when clean, and after ten to twelve months this increase of power required would amount to from 40 to 50 per cent.

For vessels, therefore, that have to keep the sea for twelve months without docking, the conclusion is irresistible that they must be sheathed to maintain their speed efficiency, and that the saving in docking and cleaning expenses and in fuel must be a handsome return on the extra expense of sheathing.—Marine Engineer.

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THE AVONDALE MARBLE COMPANY'S NEW CRANE.

There is now in operation in the quarries of the Avondale Marble Company, at Avondale, Pa., what is perhaps the largest derrick yet erected, and the most powerful in lifting capacity. This derrick covers a circle 160 feet in diameter, and can raise or place 100 tons straight lift at any point within this circle. It is operated entirely by steam power, the boom, as well as the load, being raised and lowered and the derrick rotated on its centers by this means; and these three motions are entirely independent of each other, or can all of them be operated at the same time.

The power is applied from a large capstan especially constructed for the purpose, a view of which is shown in one of our illustrations. The main shaft of this capstan is directly connected with the shaft of a 40 horse power stationary engine, the capstan shaft bearing at certain points paper friction pulleys. The winding drums are set in motion by band wheels being brought to bear against these pulleys by means of cam boxes, operated by the different levers in front of the machine, and the shafts of these band wheels being suitably geared to the winding drums. The main hoisting drum is geared to lift its full load (40 tons single line) at a speed of 12 feet per minute, and for light loads up to 10 tons single line, by means of a clutch, the speed can be changed to 48 feet per minute. The boom hoist is geared to a speed of 70 feet per minute, and using seven parts of rope between mast and boom, raises the boom with full load at rate of 10 feet per minute. The turning drum rotates the derrick—by means of a large bull wheel 12 feet in diameter at the base of the mast—at the rate of one complete revolution of the derrick in three minutes. The main hoisting rope runs directly from the capstan around a sheave in the foot block, through the center of mast, over another sheave turning on same pin as boom socket, and directly up the boom to the boom cap, passing over several trolleys on the way, and thence over the sheave in outer end of boom to the load.

The boom fall runs back from the capstan to a snatch block at the side of the quarry, thence over the capstan house to the top of the mast, through center of mast to sheave in boom head, and thence through the two triple blocks to the boom end. By this method the derrick can make a full revolution without twisting the two ropes, as in the old method of having both ropes enter the foot of mast, besides having many other advantages, which will be apparent to any one acquainted practically with the use of old style derricks.

Another point worthy of note is that all sheaves turn on pins in main castings, and the timbers are practically uncut, adding greatly to their strength and durability. This is rendered practicable at the outer end of boom by an ingenious arrangement called a "follower," which keeps the main hoisting rope on the sheave in any position; this consists of two iron spools between which the rope passes as it leaves the sheave, which spools turn on pins, and which pins in turn are fastened in one end of arms, the outer end of which arms are fastened back to the ends of the sheave pins.

One of our illustrations shows the derrick lifting a large platform, and gives a good idea of the method of rigging and the style of castings used.

The guy cap rests on small bearings, all sheaves are phosphor bronze bushed, the ropes leading from mast to capstan pass over trolleys, keeping them off the quarry bottom, the turning rope, by a special appliance, is "gathered" as it leaves the bull wheel and let down to same level as the other transmission ropes, so that they all run through the same ropeway, and everything done that experience could suggest to make this derrick the most complete and durable, as well as the largest of its kind. Some idea of the size of the derrick can be obtained from the following figures: Length of the mast, 105 feet 6 inches; length of boom, 90 feet 6 inches; mast, 31 inches square at base, 26 inches diameter at top; boom, 25 inches diameter at base and 21 inches at top; mast socket, 30¼ inches diameter by 26 inches deep; mast hood, 24⅝ inches diameter by 26 inches deep; boom socket, 24 inches diameter by 25½ inches deep; boom hood, 20 inches diameter by 21¼ inches deep, all inside measurements; guy cap, 48 inches diameter; guys (8), 1¾ inches diameter, best galvanized rigging cable; main hoisting rope, 1¼ inches; boom fall, ¾ inch, and turning rope, ⅝ inch diameter, best crucible steel.

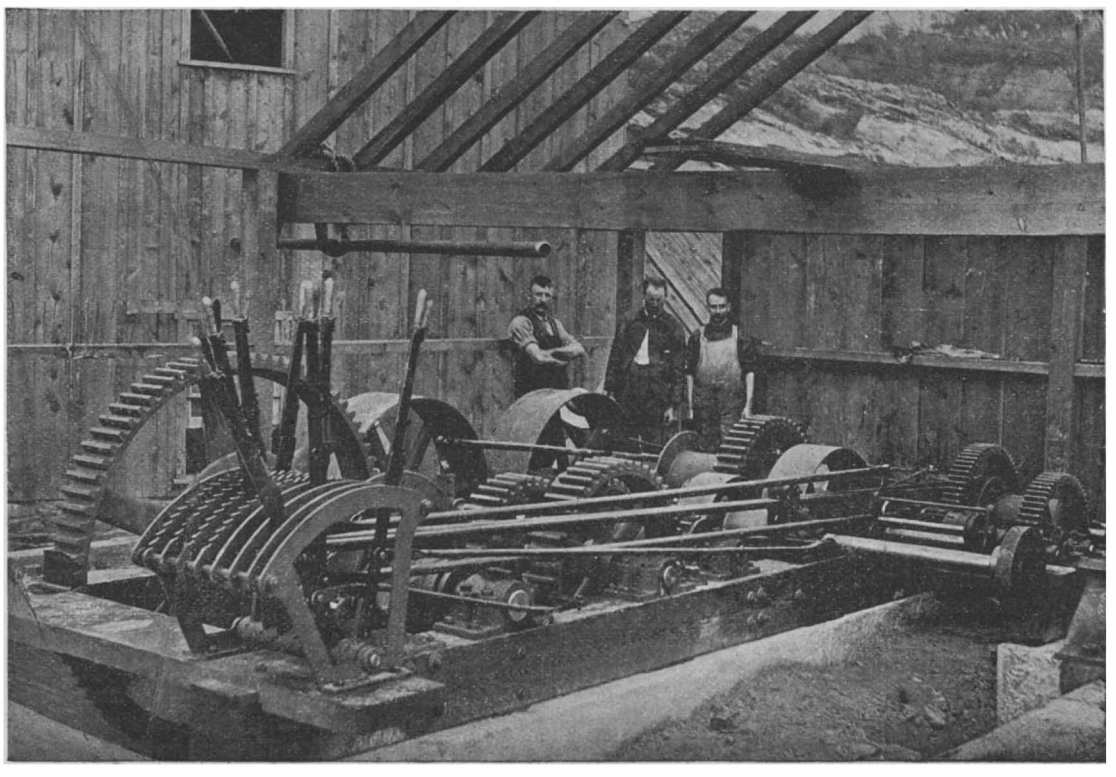
Total length of wire rope in derrick is 5,550 feet, or over one mile, the guys alone taking 3,000 feet; the castings for the derrick weighed over seven tons; the large gear wheel on main hoisting drum of the capstan is 72 inches diameter by 8 inches face; the large band wheels, 4 feet in diameter by 14½ inches face.

The timbers are the best Oregon pine, and six of the largest flat cars were necessary to transport them to the quarry.

This derrick and capstan were erected for the Avondale Marble Company, who recently discovered a valuable deposit of superior white marble immediately below their already extensive workings, from which for a number of years they have been supplying in large quantities a high grade stone for ordinary building and heavy masonry purposes. The crane was put in for the purpose of deepening their present quarry to the level of this marble and for working the latter when reached. The timbers for the derrick were furnished by Messrs. Holder & Smith, of South Brooklyn, the wire rope and cable by Messrs. John A. Roebling's Sons Company, of Trenton, N. J., and the derrick castings and capstan by Messrs. Smith, Whitcomb & Cook, of Barre, Vt.

The derrick and capstan were erected by Messrs. Smith, Whitcomb & Cook under the immediate charge of their Mr. W. F. Howland for the derrick and Mr. F. E. Kinney for the capstan.

THE NEW CRANE, AVONDALE QUARRY.



CAPSTAN OF THE AVONDALE CRANE.

An Efficient Village Improvement Society.

Southampton, Long Island, has a village improvement society well worthy of imitation. The roads and lanes, as most of the winding streets are called, are kept in fine condition and their names, with the date of their opening, are placed where "he that runs may read." Spots of special historical interest are also suitably marked. The society has done what it could to perpetuate some of the musical Indian names; for instance, the pretty sheet of water called by the early settlers "Town Pond," is now "Agawam Lake." It extends from "Job's Lane, opened in 1663," to the dunes along the beach. The "Dune Road," opened in 1654, is lined on the shoreward side with the luxurious cottages of the New York people whose summer homes are here. "Meeting House Lane" leads around to the site of the original settlement, now covered by cultivated fields; an ample sign board shows where the first meeting house stood.

Thus has the improvement society made a drive about the beautiful old town a means of gathering interesting historical information. The thoughtful visitor can hardly fail to wish that many towns in our country which have a past might have the outline given along their streets after the manner of this first English settlement on Long Island.

Armor Plate for Russia.

The Bethlehem Iron Company has received a cable message from Lieut. J. F. Meigs, at St. Petersburg, announcing the acceptance by the Russian government of the first lot of armor plate on the iron company's contract with the imperial Russian marine.

The lot includes about 700 tons of nickel steel armor that is not face hardened. The ballistic plate was tested on July 12. It weighs 23 tons and is 16 inches thick, tapering to 8. It measures about 14 feet in length and 7½ feet in width. The Bethlehem Iron Company was represented at the test by Lieut. Meigs, its chief of ordnance.

Krushite.

Krushite, the new abrasive material, consists of chilled cast metal shot, varying in size from that of clover seed to a mere powder. The individual particles are said to be so hard, and at the same time so tough, that if one of them be struck on an anvil, the latter will receive a dent. Krushite is claimed to be three times as effective per unit of weight as the sharpest sand for sawing blocks of granite, polishing, etc., and as a substitute for sand in the blast and for diamond drills in boring. The wear on the saw blade, or rubber, is also said to be considerably less.

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HYDRAULIC CAISSON SINKING FOR FOUNDATION PIERS.

Engineers will be interested in the method adopted in sinking caissons or cylinders through strata of earth to bed rock, for foundations of any superstructure, which we illustrate herewith, although the principle is not new. Piles have repeatedly been sunk in a similar way, that is, by forcing down to the bottom of the hollow pile a stream of water of sufficient quantity and force to wash out a cavity into which the pile may drop. Mr. William D'H. Washington, of this city, has applied this principle to sinking larger cylinders; and in the preparation of the foundations for a 16 story building at Broad Street and Exchange Place he has shown that it may be successfully done.

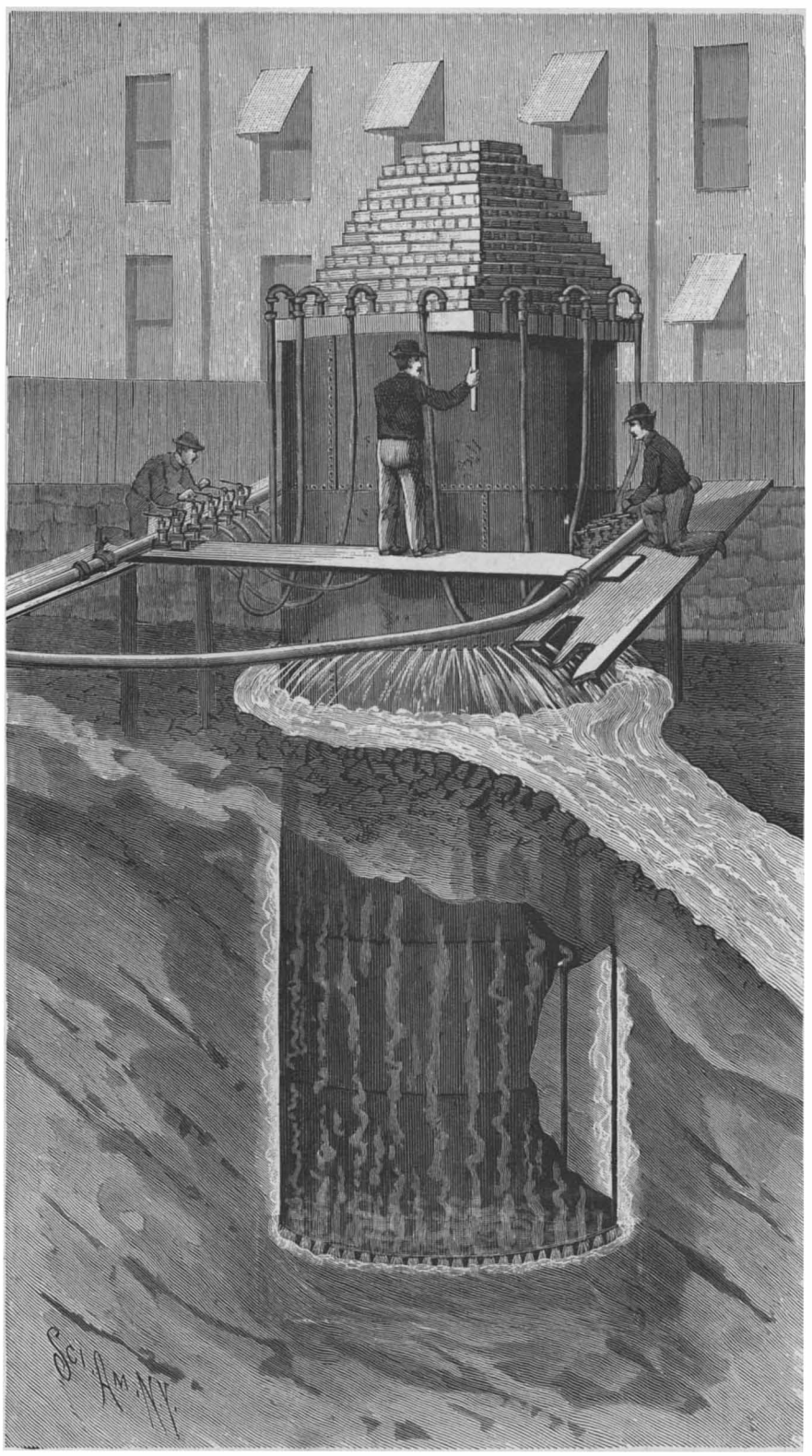
The character of the ground necessarily enters largely into the successful use of the agency of water in sinking either piles or cylinders. At this point the ground was generally stiff, but quicksands were liable to be met with. The building for which these cylindrical piles are used to facilitate putting down foundations will weigh about 30,000 tons and occupy a plot of land 88 by 150 feet. The bed rock, to which the cylinders are being sunk, is 42 feet below the sidewalk, and 44 of these cylinders are employed, from 6 to 13 feet in diameter each, and about 27 feet long—the length required to reach bed rock from the cellar of the old building occupying the site.

The operation consists in sinking open steel cylinders by the use of water jets issuing from hollow castings bolted to the bottom edge of the cylinders, the lower edges of the castings being sharp. The water is forced down to the jet openings through pipes on the inner edge of the cylinder, the outer ends of the pipes being connected by flexible tubes to valves in the main supply pipe from the pump. The cylinder shown in our illustration was 10 feet in diameter, and as it sank additional segments were added until, at about 28 feet, the lower edge rested upon the bed rock.

As will be seen in our view, the top of the cylinder is weighted, about 30 tons having been placed there to assist in the sinking. As the ground at the bottom edge of the cylinder is softened and partially washed out, a current is established to the surface by the outer and inner surfaces of the cylinder, thus lubricating both surfaces as it were, and the cylinder readily drops into the soft ooze.

The cylinder is kept in a plumb position by closing the water valves in the pipes leading to the lowest edge and allowing the flow to the higher edge to continue until the cylinder cuts its way and settles to a true vertical position, levels being constantly applied during the sinking. Obstacles like timbers have to be cut away, but bowlders may be generally got rid of by driving a small pipe down to the obstacle and washing out a cavity by its side, into which it is forced by the edge of the cylinder. The rapidity with which these cylinders have been put down is remarkable, one cylinder having been sunk 26 feet 6 inches in one and a half hours, and on another occasion when soft quicksand was encountered a record of 10 feet in five minutes was made. The water pressure in the pipes varies, according to the depth, from 25 to 150 pounds.

The core of the cylinder is subsequently removed by digging in the ordinary way, and the cylinder filled with the usual concrete base and brick masonry.



HYDRAULIC CAISSON SINKING FOR FOUNDATION PIERS.

FROM the action of sulphuric acid on the gas from cleveite, M. Deslandres has obtained in the extreme red of the spectrum the third of the four lines in the solar spectrum that had not been found on the earth. This leaves only one permanent ray from the solar atmosphere, the green line, known as "the line of the crown," yet to be discovered in earthly substances. It probably belongs to some gas lighter than hydrogen.

IMPORTERS of sewing needles made in Germany are able to sell them in this market on a profit at fifteen cents per one thousand needles. This is for the common quality. The better qualities sell for from forty to sixty cents per thousand. At present there is no duty on needles.

Coal Deposits of Kachemak Bay, Alaska.

The arrival at this port of the American bark Theobald, with a cargo of coal from Alaska, renews interest in Kachemak Bay, Cook's Inlet, in the northernmost part of that territory. This coal indicates its probable importance. Like all coals on this coast, it has a considerable percentage of water, which, while against it for coking, is in its favor for other purposes. Tests, some of which were extended over a period of several months, of the coal have demonstrated that it burns clean, is remarkably free from soot and smoke, and has good heating qualities; and while with a strong draught it will burn rapidly, yet with a light draught it will make a strong and hot fire lasting for a considerable time. From all information obtainable, it seems not unlikely that this coal may aid in solving the problem of cheap fuel supply for use in manufactures, steam vessels and some domestic purposes.

These coal deposits embrace a territory of 300 square miles. They underlie that portion of the peninsula between Kachemak Bay and Cook's Inlet. How much of this is practically available has not as yet been determined, but surveys and examination have shown the existence of large quantities. Eighteen veins have been examined, which vary in thickness from a few inches to five and six feet. The coal in these veins differs in quality, some being of sufficient thickness and character to warrant profitable working. As the entire geological formation of the coal deposits belongs to the Miocene period, they are of a lignitic character, some being very frail, decomposing or crumbling on exposure to the atmosphere, while others are strong and highly carbonated and will stand shipment as well as any coast coal. Owing to their peculiar local conformation (dipping into the mountain at a decline of not more than two feet to the mile), they can be mined at a comparatively small cost, no shaft work or heavy pumping being required, obviating the need of an expensive plant to be maintained. Mr. George R. Tuttle, who has spent many years in coal and gold mining, made a personal visit to these coal deposits in Alaska. He says this coal is desirable for grate and all kinds of domestic use, for which it takes rank alongside of Scotch splint, while for manufacturing and general economic purposes these coals will be found among the best varieties brought to this market. Very little of the "Alaska splint" coal has been brought to San Francisco, and that was taken from the outcropping of the vein, where it had become air-slaked and devitalized by exposure to the elements. It is thought that when the present company—the North Pacific Mining and Transportation Company—shall have extended its mining operations farther into the formation, the quality of the coal produced will be still more desirable. While the distance to the coal fields is relatively much farther in miles than to our present base of supplies in Washington and also in British Columbia, yet the lesser expenses for mining, putting on vessels, and the absence of river tolls, harbor dues, towing, piloting, etc., will enable the coal to be brought from Alaska at sufficiently low cost to warrant entering into competition for the demand of San Francisco and the California coast, and will yield to the owners a fair net profit.

The annual report of the Geological Survey is to hand; speaking of the production of coal in California during the past year, the report says:

"The total product in 1894 was 67,247 short tons, of a spot value of $155,620. The decreasing tendency of coal production in California noted in a preceding volume of the mineral resources continued in 1894. The largest product in any one year was obtained in 1889, when it reached 121,820 short tons. In only one other year did it exceed 100,000 tons. This was in 1890.

"California coals are of inferior quality, mostly lignite and high in moisture or ash, or both. They can, however, and do, to some extent, act as a balancing wheel in keeping prices for other coal at a reasonable figure. Consumers are willing to pay higher prices for better coal, but there is a limit beyond which it is found impolitic to go, and California lignites would be found cheaper fuel, notwithstanding their inferiority."

This fact should be borne in mind by consumers in San Francisco, and encouragement should be given to the development of such mines as the State has. As it is, prices for coal in San Francisco have materially declined in the past few years. In 1890, English coal was selling at from $10 to $13 per ton. At the close of 1894 it was much cheaper. Such cheapening of fuel is of great benefit to manufacturers.

It is true that the decline in value was originally due to heavy importations, chiefly in 1891, when the total receipts exceeded those of the previous years by nearly half a million tons and resulted in a glutted market, but unless there should be other resources for consumers to fall back upon, the present low rate will not be apt to continue. The statistics for 1894 are as follows: Contra Costa County, total production, 39,200 short tons; Amador, Fresno and San Diego, 28,047 short tons, making a total for the State of 67,247 tons, valued at $155,620. In 1893 the total production was 72,603 tons and the total value $167,555.—Min. and Sci. Press.

Waterproof Varnish.

This formula for varnish is well adapted for the protection of prints on glass against humidity; moreover, it keeps well. Here is the mode of preparation:

White gum lac	27 to 32 parts.
Borax	8 "
Carbonate of soda	2 "
Glycerine	1 to 2 "
Water	320 "

Dissolve the borax and the carbonate in 160 parts of warm water, and place in the solution the gum lac, which has been broken into small fragments. Place on the fire the vessel containing the mixture, and agitate until the lac is dissolved. Allow to cool, filter, and afterward add the glycerine and the quantity of water necessary to complete the 320 parts. At the end of a few hours a deposit is formed; after filtration the liquid should have an amber-yellow color.—L'Amateur Photographe.

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THE RAWHIDE CANNON.

A curious weapon, nothing more nor less than a cannon chiefly made of rawhide, was subjected to official tests on July 23 by the Ordnance Board of the United States Army, at the proving grounds, Sandy Hook.

The gun consists of an inner tube of steel, around which is wound strips of rawhide to a combined thickness proportionate to the intended charge which the gun is to carry. The exterior of the raw hide is then inclosed in a shell of metal. The weapon when finished has the general appearance of an ordinary cannon, but is rather more bulky.

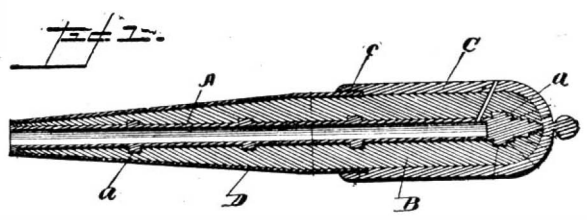
The inventor of this curious piece of artillery is Mr. Frederick Latulip, of Syracuse, N. Y., and he obtained a patent for the invention June 26, 1894, from which we take the following description:

"The principal objects of the invention are to cheapen and lighten the construction of guns and gun barrels, and, at the same time, to so strengthen the same that they will withstand the explosive strain of not only the usual charge, but an unusual one.

A indicates a core of steel or other suitable metal, properly bored, and provided with exterior collars or bands, a, arranged at intervals thereon. These collars or bands are cast integral with the core and serve to prevent endwise movement of the rawhide casing during firing. The breech portion of the core is provided with a series of step-like depressions, a.

B indicates a casing of rawhide surrounding the core, and before being applied is treated as follows, viz.: I take the ordinary dried commercial rawhides and soak in water sufficiently to soften the hides and remove the lime therefrom. The hides are then well fleshed and split into thin layers in any well known manner. These layers are then soaked in a bath of liquid ammonia for from ten to fifteen minutes, after which they are thoroughly dried and cut into strips of the width desired for winding. The strips are then subjected to a bath consisting of a solution of sulphuric acid and water, in about the proportion of one part of acid to thirty-two of water, for about ten minutes. A bath of pure naphtha might be substituted for the sulphuric acid one above mentioned with equally good results. The effect of either of these baths is to cause a drawing or exudation of the oil or grease contained in the rawhide strips. The result of this treatment leaves the strips, when they are dried, hard and tough like horn, and possessing great strength.

In winding the strips around the core, cement is first applied to both surfaces to cause the successive overlapping layers to adhere, and this application of the cement also serves to soften the rawhide sufficiently to permit of easy and perfect winding; and in winding, the spaces or seats between the collars or bands are first filled. The strips are wound tightly around the core between said points in spiral overlapping layers until the spaces or seats are filled flush with the tops of the collars or bands, the cement, pressure and strain causing the layers to adhere firmly. After the spaces or seats have been filled with the rawhide layers, the breech is then wound in a like manner. In winding the breech I commence at the outer end and wind the strip around the core, filling the first step or depression, and, when filled even with the second step or depression, the winding is continued until both of said steps or depressions are filled flush with the third step or depression, and so the winding continues until the breech is incased flush with top of the first collar or band, a. After all of the spaces or seats and depressions are filled with the spirally wound overlapping layers of rawhide the winding is continued the entire length of the gun until the required thickness is obtained, after which the gun is placed in a suitable lathe and the rawhide casing is turned down to the desired shape. When turned down to the required shape a steel cap, C, having a groove or rabbet, c, is fitted tightly over the breech portion of the thus far constructed gun, and a steel shell, D, conforming to the



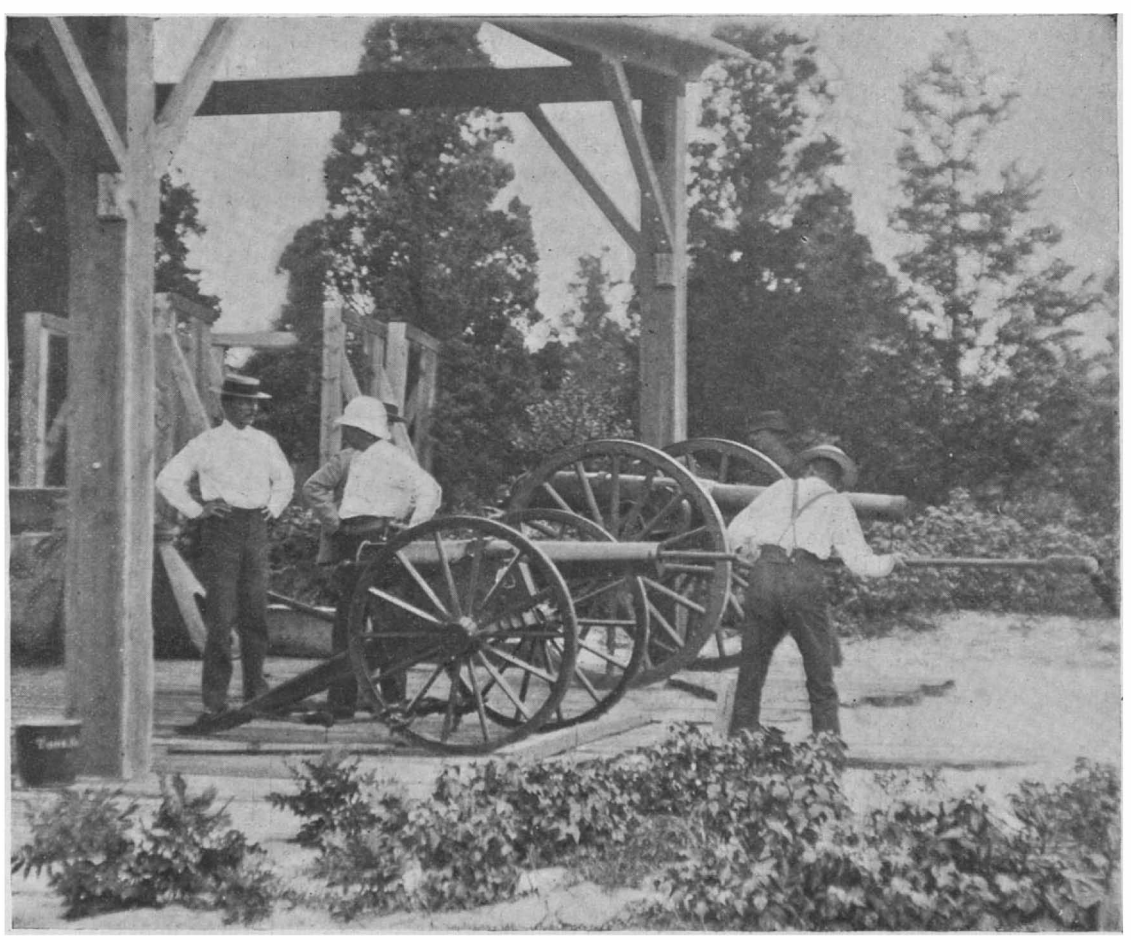
taper of the forward portion of the gun is forced over the rawhide until its inner end fits snugly within the groove or rabbet, c, of the cap, where they are secured together. The cap, C, is provided with the usual trunnions.

In place of the shell, D, I may provide the rawhide casing with a wire jacket, and instead of making the core breech solid, as shown, I may make it with a screw-threaded opening closed by screw-threaded breech block.

In constructing gun barrels I provide the core with the collars or bands as in the larger gun, and wind the rawhide strips around the said core in the same manner, filling the spaces or seats first, and then continuing the winding until the desired thickness is reached. After being turned down, a shell is forced over the rawhide casing until its inner end abuts against the abutment, to which it is brazed or soldered.

By constructing guns and gun barrels as hereinbefore described, the tendency to transverse and longitudinal rupture is reduced to a minimum, as the rawhide gives the necessary tension to withstand the explosive strain of the charge.

The principal claim is for a gun having a metallic core provided with retaining collars or bands, an intermediate casing of rawhide and a metallic covering for said casing."



LOADING THE RAWHIDE CANNON.

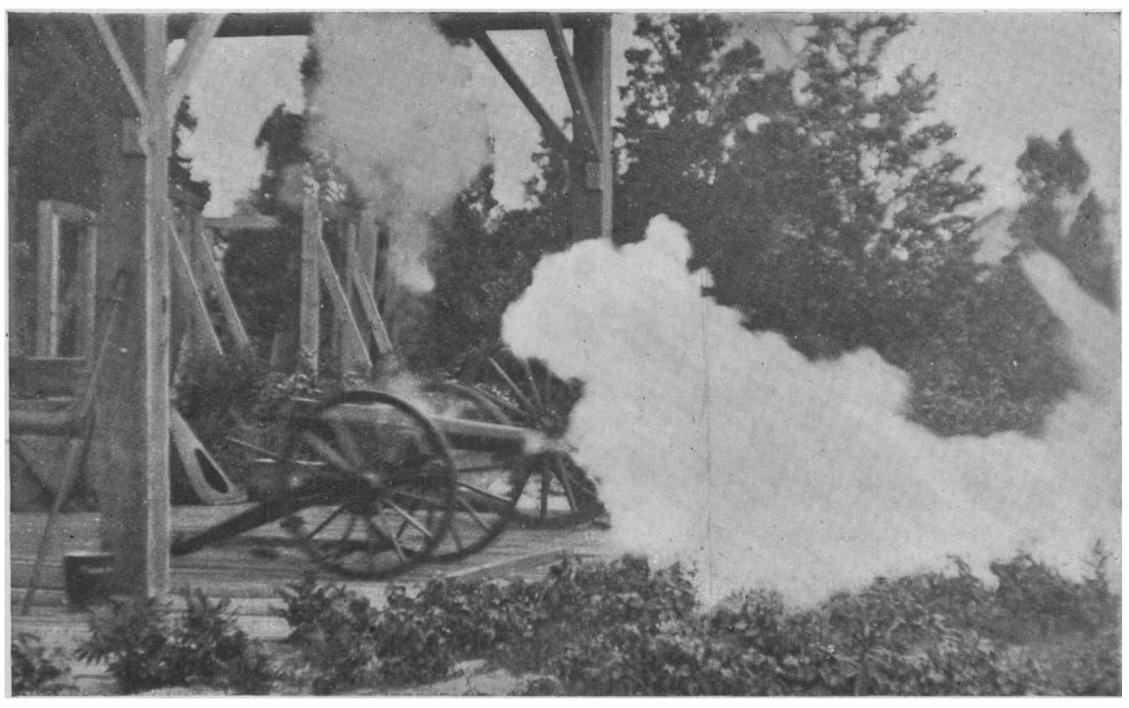
We give herewith two photographic illustrations of the new gun specially taken for the SCIENTIFIC AMERICAN. One represents the loading of the gun, in the other its appearance at the moment of firing. The New York Sun gives an excellent account of the proceedings, from which we abstract the following:

The cannon held its own against very severe tests. It successfully withstood a pressure of 30,369 pounds to the square inch, but the recoil after this shot broke the trail of the gun carriage, and further tests were impossible, no other carriages being available at the time. The War Department ordered the Ordnance Board to test the cannon carefully. In Syracuse they have been firing the gun privately in an armory for a month past.

The principal claims made for the gun are that it is only about half the weight of an ordinary steel gun, that it is just as durable and much stronger than a steel gun, and that any number of shots can be fired from it in rapid succession without heating it.

The rawhide gun used July 23 was not a very formidable affair. It was 5 feet 8 inches long and was of 2½ inches caliber. It was mounted on a most elaborate gun carriage, which Mr. Link, the assignee, informed the board was made by the finest wagon maker in Syracuse. The gun weighs 456 pounds, and, according to the diagram, is made up of layers of steel, rawhide, and copper wire. The bore is of steel, ¾ of an inch thick at the muzzle and 1½ inches thick at the breech. The rawhide is 1 inch in thickness at the muzzle and 3 inches in thickness at the breech, and is cut in 4 inch strands. Around the whole is wrapped two layers of heavy copper wire. The gun looked strong enough to stand an ordinary charge, but not an officer present believed that there would be much more than a few bits of the carriage left after the first of the heavy tests had been made. Mr. Link thought otherwise. He walked proudly around his cannon, giving it affectionate pats every now and then, and inviting the officers to blaze away and "bust her if you can."

The officers smiled significantly at each other, and Lieut. Ruggles was ordered to go ahead with the tests. Those who had attended gun tests at the proving ground before noticed that this test was not to be made at the usual place. The gun had been hauled some distance inland, where there is a large



FIRING THE RAWHIDE CANNON.

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number of earth works, and had been placed about fifty yards in front of one of these huge piles of sand and earth, for reasons which became apparent later.

The workmen at the proving ground didn't seem to like the work of loading the gun, because, since it was built on the old-fashioned plan, they had to insert powder and balls in the muzzle and then drive them home with a ramrod. All the modern guns are breech loaders, and the men at the proving ground don't know much about any other kind of guns.

There was considerable discussion as to the amount of powder to be used in the first test. Some of the officers wanted a heavy test for a starter, their idea evidently being to settle matters quickly. It was finally decided to put a pound of ordinary powder in for a start, and when all was in readiness three lanyards were tied together so as to give the gunner plenty of opportunity to escape flying debris in the event of an accident. Then the whole force retreated behind the bank of sand so as to give the gun plenty of room.

The gunner concluded that he'd better get behind the hill, too, and so he secured another lanyard to the already long line and joined the rest of the company. At the word he fired, and although everything seemed to have gone all right, the officers didn't come out from behind the hill until the smoke had cleared.

They seemed surprised to see the gun intact. Mr. Link smiled while the Ordnance Board held a consultation with Lieut. Ruggles, after which a pound and a half of musket powder was placed in the gun. The gage showed after the first shot that the pressure had been 5,471 pounds to the square inch, while after the second shot it registered 16,840 pounds. The third shot, it was thought, would settle the cannon, and two pounds of powder were used, but it didn't, though the gage showed a pressure of 26,708 pounds to the square inch. The officers looked surprised, while Mr. Link in his joy got out his nerve tonic, took a drink, and then murmured to the Sun reporter:

"Ain't she a peach ?"

There was nothing for the board to do but to go on with the tests, and they ordered Lieut. Ruggles to go on up to a pressure of 35,000 pounds. In order to obtain this pressure it was decided to use two balls, and while preparations for the shot were going on the members of the Ordnance Board slowly withdrew from the scene. Capt. Crozier found that he had some business at headquarters, and Capt. Heath went up to give some instructions to a gang of men who were getting a 500 pounder ready for a test about half a mile away, while Major Phipps was suddenly overcome with thirst and started for the pump to get a drink. There was a rush for the sand bank when the gun was loaded, and when all hands were safely ensconced behind it, the charge was fired. It didn't phase the cannon a bit, and it was still intact when the officers crept out from behind the sand bank again. The gage showed that the pressure with two balls had been only 26,345 pounds, and so it was decided to use three balls and two pounds of quick rifle powder.

Mr. Link looked a little bit anxious when this was announced, but told the officers to go ahead. The pressure from this last shot was 30,360 pounds to the square inch, and, though the carriage gave way, the gun stood it nobly. Mr. Link went into ecstasies over it, while the officers looked a little disappointed. The members of the Ordnance Board came around after the last shot, and seemed very much surprised to find the cannon intact. They said there would have to be some more tests, and there were wicked gleams in their eyes as they said it, but all Mr. Link did was to chuckle and say: "Blaze away all you like. That's what she's here for."

The cannon was perfectly cool after every shot. The average recoil was about six feet. Major Phipps said after the test that the gun to be of any use would have to be a breech loader. Mr. Link said that he could build a breech loader just as easily as a muzzle loader, and that it would be just as good. The tests will be resumed in a few days.

The Encyclopedic Dictionary.

The cheapening of books and all kinds of reading matter is one of the most distinctive features of the age, and as a consequence of the vastly increased range of subjects brought to the attention of the general reader, the ordinary dictionary does not nearly as well meet the wants of the public as it did a generation or two ago. It seems to be demanded that the dictionary shall be also encyclopedic in its character, affording as concisely as possible a compendium of the world's knowledge, but without occupying as much space or costing as much as would a large library. A dictionary of this class, recently brought out by the Syndicate Publishing Company, of No. 237 South Eighth Street, Philadelphia, Pa., is more fully described in our advertising pages. The work is contained in four quarto volumes of 5,357 pages and over 3,000 illustrations, having over 250,000 words and treating of more than 50,000 subjects. It forms in itself a library for the busy man of affairs, the mechanic ambitious to advance himself in his line, or the student or apprentice just making a beginning; and, for the purpose of insuring for it a wide circulation among those of limited means, the publishers agree to send the whole four volumes to any subscriber on receipt of $2 and an agreement to pay $2 additional monthly until the sum of $16, the price of the work, is paid. The work is a valuable one, and by this method of sale it is placed within the reach of thousands of persons who would otherwise be unable to become its possessors.

Natural History Notes.

Feeding Habits of Certain Birds.—Some interesting observations have recently been made by the chief of the Division of Ornithology of the Agricultural Department concerning the habits of birds that are supposed to be enemies of the farmer. It is said to have been proved conclusively that 95 per cent of the food of hawks, owls, crows, and blackbirds consists of animals and insects that are far more dangerous to agriculture than are the birds themselves. The charge against crows is that they eat corn and destroy eggs, poultry and wild birds. Examination shows that they eat noxious insects and destructive animals, and that although 25 per cent of their food is corn, it is mostly waste corn picked up in the fall and winter. With regard to eggs, it was found that the shells were eaten to a very limited extent for the lime. Crows also eat ants, beetles, caterpillars, bugs, flies, and grubs, which do much damage. The cuckoos also are found to be very useful birds.

The Upas Tree.—During his recent stay in Java, Professor Wiesner ascertained some interesting particulars with reference to the celebrated Upas tree, Antiaris toxicaria. Contrary to the general impression that this tree is not uncommon in Java and the Sunda Islands, an impression manifested by the statements in the leading text books, Professor Wiesner learned that the original specimen described by Leschenhault has been felled, and in the whole of Java there were but three individual trees belonging to the genus and closely allied to A. toxicaria. Of these three trees one was found by Dr. Greshoff to be innocuous, and was therefore A. innoxia, Blume, a species supposed by many botanists to be only a variety of A. toxicaria. The second tree proved to be poisonous, one drop of the latex being sufficient to kill a dog; the third has not been examined.

The tree has, however, been cultivated in the botanical garden, and there are now in the plantation at Tjikomoh about seventy specimens. Neither in the botanical garden nor in the plantation could any ill effects be observed, even after a person having been for some time in the neighborhood of the trees; so the accounts of the poisonous nature of the exhalations from it are much exaggerated. Dr. Burck has shown that the plant gives off no injurious vapors, and that the latex is poisonous only when it passes through a wound into the blood.

Sensitive Movements of Plants.—Dr. J. M. Macfarlane publishes the results of a series of experiments on the effect of colored screens on the sensitive movements of leaves (Oxalis stricta and several species of Cassia). He finds the exciting agents of the movements to be certain of the light rays. When sensitive plants are placed behind colored screens, the leaflets fold up as in the nyctitropic state, most strongly under red, less so under yellow, only feebly or not at all under green light; while under blue screens the leaflets remain open as in ordinary daylight. In all cases nyctitropic movements are accelerated behind a red screen, not quite so strongly behind a yellow screen, while behind a green screen the movements practically coincide in time with those of exposed plants, and are beautifully regular in sequence; under blue light there is a distinct retardation of the normal nyctitropic period. Up to 38° C., or even 43° in some species, heat rays appear to fail in stimulating the tissues. The general result of these experiments is that the heat rays, the less refrangible rays, and the more refrangible rays, are all efficient up to a certain point in inciting nyctitropic movements. Orange, yellow, and green screens to the protoplasm, whether in the form of pigmented walls, pigmented cell sap, or chlorophyl, are of a protective character, and permit the normal functions to be carried on unimpeded by the injurious action of the more intense blue-violet rays.

Poisonous Property of the Shrew Mouse.—Both in England and in Germany, popular tradition in rural districts attributes poisonous effects to the bite of the common shrew mouse. Scientific naturalists have discredited this belief, but the recent observations of Remy St. Loup, published in the Revue des Sciences Naturelles, tend to show that this popular reputation for toxicity may not be groundless. He observed that cats were afraid of the animal, and having captured a specimen placed it in a cage with a common mouse. The latter, although twice the size of the shrew, fled from its companion in fright, but nevertheless was bitten in the leg by its fellow prisoner. The bitten mouse speedily developed abnormal symptoms, and on releasing it, its hind legs were found to be perfectly paralyzed. It was enveloped in cotton wool, but the next morning was found dead without having moved from where it was placed. Considering that the wound caused by the bite of the shrew was very small, it would appear that the old tradition as to the poisonous properties of its bite, at least as regards the domestic mouse, is well founded.

Fecundation of Flowers by Insects.—Mr. H. G. Hubbard describes in Insect Life a new case of fecundation of flowers by insects. It concerns a species of Philodendron, of the family of the Aroids, which is found in the Antilles. By its structure, the flower would seem especially adapted for direct fecundation were not the male organs tightly inclosed in the folds of the spathe. The fecundation is effected by coleoptera of the genus and species Macrostola lutea, which in pairs perforate the spathe, wherein the female deposits her eggs at the apex of the spadix. The young soon hatch, and detaching the spathe from the spadix, allow the pollen to fall upon the female organs situated beneath. The entire interior of the flower is very humid, so that all the young are soon covered with a paste of pollen which they carry to the neighboring flowers after the flower has opened. Such opening is due to the parent insects. The spores of fungi enter through the very small aperture made by the insects, and, developing, eat into the spathe, which is also soon attacked by the larva of a fly and by many other insects.

Amount of Light Favorable to Plants.—Herr J. Wiesner has come to the following conclusions on this subject: Those plants which, like Lemna, receive an unlimited amount of light on all sides, do not produce a maximum of organic substances. In by far the greater number of plants the amount of light absorbed is diminished by the form and position of the organs. In trees this amount is reduced, in the peripheral portion of the foliage, to one-half or one-third, in the central portion to as little as one-eightieth of the possible amount of light. All luxuriant vegetation is produced under conditions of comparatively feeble, and especially of diffused, daylight. Intense light is of no advantage to a plant growing in unfavorable conditions, especially in poor dry soil. Although the actual amount of light enjoyed by trees and shrubs is greater in tropical than in temperate regions, yet in the latter the leaves of deciduous woody plants receive a more intense light than those of the former at one particular period of the year, namely, at the commencement of the period of vegetation.

The Color of Flowers.—Schubler has found that, out of a thousand flowers, 284 are white, 226 are yellow, 220 are red, 141 are blue, 75 are violet, 36 are green, 12 are orange, 4 are brown, and 2 are black.

White flowers become proportionally more numerous in measure as one advances toward the north.

Distribution of Marine Fishes.—Mr. Browne Goode, in a paper recently read before the Society of Biology, shows that the ideas admitted in regard to the distribution of deep water fishes are erroneous. Contrary to the opinion usually held, no separation in the horizontal strata is possible. Nor is it any more accurate to say that the marine fauna of great depths is the same for all parts of the world.

The application of the method of percentages leads Mr. Goode to distinguish 11 characteristic regions and 2 subregions. These are as follows: (1) Northern Atlantic; (2) Eastern Atlantic with Mediterranean subregion; (3) Virginian Northwestern Atlantic with Mexican subregion; (4) Southwestern Atlantic or Brazilian region; (5) Northern Pacific; (6) Eastern Pacific; (7) Northwestern Pacific; (8) Polynesian; (9) Zelandian; (10) Antarctic region; (11) Indian region.

Royalties.

One of the incentives for inventors to secure patents on their inventions is the possibility that a handsome income may be derived therefrom in the shape of royalties. In the art of photography, where the manufacture of sensitized dry plates on a large scale has come to be an extensive industry, successful plate-coating machines command a good royalty. An item in the English journal Optician states that Mr. B. J. Edwards rents out on royalty twenty of his patented plate-coating machines at a yearly rent of $500 per machine. One company uses five of them. Mr. Edwards was a photographer, knew the needs, and applied his inventive ingenuity, finally accomplishing a successful result. How many thousands there must be, having inventive talent, who could improve the machinery in the lines of industry they are familiar with, to the betterment of mankind generally and themselves individually.

The example of Mr. Edwards is only one of many, where success is attained in the invention of practical and needful improvements, and should inspire others to make use of their inventive talents.

A New Anthracite Vein.

Anthracite coal in a vein four feet thick has been discovered on the Line Mountain, which bounds Schuylkill and Northumberland Counties. The vein is on the south side of the mountain, near Pitman, in the former county. This is a surprise to coal experts, for it is five miles south of the Shamokin coal basin, and was believed to be outside the coal district.

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A FLYING DORMOUSE.

Among the animals in the last collection sent from Cameroons by the explorer George Zenker was a mammal of an entirely new species, a flying dormouse, to which the name Idiurus Zenkeri has been given. We publish herewith an engraving of this little animal, for which we are indebted to our worthy contemporary, the Illustrirte Zeitung, and which shows plainly the membrane that extends around its body and enables it to fly or jump from branch to branch. Such membranes are well known among animals of certain species, but it is distinguished by the peculiarities of its very long tail from all other mammals. In the cut the tail is shown slightly curved, so that the under side can be seen. At the root of the tail there is the fold of skin, behind which are fifteen oblique rows of little horny scales, three or four in each row, short bristles protruding from among the scales. On the under side of the tail, along the middle and the sides, are comb-like hairs, and from the short, soft fur on the upper side—from the root of the tail to the brush-like tip—project long upright hairs. No one knows for what purpose this singularly shaped apparatus is intended, for as yet nothing is known of the life of the little creature. Nor is anything known of its origin; it has been called "flying dormouse," because it resembles this sluggard in the shape of its body, its skull and its teeth; but its membrane and the horny scales are similar to those of certain species of squirrels, and its skeleton shows peculiarities possessed only by the jerboa. Probably the dormouse, the species of squirrels referred to, and the jerboa are the last of a very large extinct family.

THE FLYING DORMOUSE FROM CAMEROONS—FROM A DRAWING BY ANNA HELD.

Giant Kites for Scientific Purposes.

Ten giant kites, all on one string, will be flown, if possible, to the height of two miles, by the Weather Bureau authorities at Washington. This, of course, would be many times higher than any other kite has hitherto traveled, the famous Eddy kites (see illustration in SCIENTIFIC AMERICAN, Sept. 15, 1894) having flown only 4,000 feet, according to latest reports.

This will be done in connection with systematic studies of the upper atmosphere, which region has heretofore been explored by scientists only with the aid of captive balloons carrying thermometers, barometers, etc. But balloons are found to be most impracticable for such purposes, since the wind blowing against them keeps up an almost constant vibration, while its force against their envelopes causes great leakage of gas, and hence makes a flight of many hours impossible.

The kite experiments to begin this summer will be conducted by Prof. Adie, the same meteorologist who is making extensive photographic studies of lightning flashes. The investigation of the upper atmosphere will be made first, with a view of ascertaining the differences of temperature for various altitudes in free air. Other experiments, by aid of the kites, will follow these, all of which are expected to enable the bureau's meteorologists to make a great profile map of the atmosphere, which task has never yet been accomplished. Temperature and barometric curves, electric currents, etc., will be located for various parts of the country and for different seasons of the year.

Such data will be as necessary to the engineers of flying machines, when practically perfected, as charts are to sailors. Ballooning can be then carried on with much less risk than at present, since it will be an easy matter to determine what currents of air are likely to be met at various heights, just as it is now a small task to find the Gulf Stream or the trade winds. A still greater service will be rendered by this information to scientists, who now believe that men will be able to soar like birds as soon as the upper air currents are definitely understood.

Kites will be flown to different heights in hot waves during electric, wind, or rain storms, in cold waves during snow or hail storms, and in fact during every possible phase of weather. It is now the purpose of the experimenters to construct this summer a giant kite, which will revolutionize the whole science of kite-flying. This will be no less than a combination kite balloon. The length and width are not yet determined, but in form it will be a large, flat box, about a foot in thickness, the light frame being covered with gold beaters' skin. It will be inflated with hydrogen gas, which would give to a kite of the dimensions of the present design and a foot thick a lifting force of three pounds. This would be sufficient to take the kite up, notwithstanding the general buoyancy offered by the wind currents.—Washington Star.

Why Our Boys Should be Taught Spanish.

It is the manifest destiny of this country, sooner or later, to monopolize the great bulk of trade with South America, and one of the prime essentials to this desired result is a thorough knowledge of the language spoken by her people, which, to a very great extent, is Spanish. But very little attention is paid in our institutions of learning to teaching this language, and its need will be most seriously felt in commercial circles within the next generation. Our able contemporary the Boston Journal of Commerce quotes from the Philadelphia Record upon the subject of acquiring a knowledge of Spanish, in which the editor says:

"Our commerce with the Central and South American republics is largely increasing every year. Even slow-going Mexico is becoming alive to this fact, and is accordingly making an effort to capture some of the commerce flitting hitherward and thitherward. She is actually going so far as to listen to the scheme which is being advocated for the formation of a United States of the Latin-American republics of the central portion of the continent—a confederation which, with Mexico as a part, would very largely increase commerce between this country and the new United States to the southward. The commercial possibilities of these Latin republics are exceedingly vast. Our present commerce with those countries is as nothing to what it will be twenty-five years hence, when a knowledge of the Spanish language will be absolutely essential to all young men engaged in the counting houses of the firms engaged in business with that part of the globe. Let parents and pedagogues, therefore, cease their bickerings as to the respective merits of Greek and French, and put into the boys' heads a practical knowledge of Spanish, which they will find it not difficult to build upon a tolerably fair foundation of Latin. French may be the language of refinement, and as such its acquisition is more or less desirable. But the great languages of commerce not many years hence will be our own language, the German language, and that charming tongue for which this plea is made—the tongue of Cervantes and of Cortez."

A New Process in Steel Making.

The Carnegie Steel Company at Homestead tested July 17 a new plan which Manager Schwab and Chief Electrician Kinkey have devised for reheating molten metal that has become chilled before it can be poured into the moulds. The new plan consists in using an electric current, by which an intense heat is generated. The molten steel was set to bubbling, and the light and heat were so intense that the workmen's eyes suffered seriously, but at the next test they will wear glasses. The experiment was successful.

London's Pneumatic System.

Telegraphing over short distances—as within towns, for instance—is a very costly operation. It requires the same number of operators—one at each end—and the same number of instruments as for the longest distances. But compressed air will blow a telegraph form through a metal tube as far as two or three miles in as many minutes; and steam engines are used to compress the air by means of which the pneumatic tubes are worked. The engine room at the central office resembles nothing so much as the engine room of a great steamship, except that the engines are on the "beam" principle, as being best suited to the peculiar work in which they are engaged. They are magnificent specimens of the engineer's craft, and have a stately appearance, due, in large measure, to their leisurely stroke as compared with the hurried action of the marine or electric light engine. Night and day these engines are employed in pumping air into, or exhausting it out of, huge "containers," which are connected with the tube room overhead. There are no fewer than thirty-six pneumatic tubes radiating throughout the metropolis, buried under the pavement among the gas and water pipes, and every now and then crossing the path of the telegraph wire, whose handmaids they are. It is desired, say, to send a message from St. Martin's le Grand to Charing Cross. Here is a tube-like, felt-covered box which will contain one or a dozen message forms at pleasure. Place the form inside; secure the open end of the box, or "carrier," as it is called, by means of an elastic band; insert the box in the mouth of the tube; admit the compressed air, and away it goes across Newgate Street, along Paternoster Row, down Ludgate Hill, up Fleet Street, and along the Strand, where, at No. 448, it projects itself under the nose of the attendant with a thud and a rebound, in almost shorter time than it takes to describe the operation. All the air is stored at the central office, so that if it be desired to reverse the operation—i. e., to send a message from the West End to the City—it is only necessary to transmit an electric signal, when vacuum is turned on, and the "carrier" is sucked back which a minute before had been blown out. The tubes are, in fact, gigantic pea-shooters.

What may be called the working gear of the tubes is in itself a most interesting sight. It has been mostly designed by officials of the Telgraph Department, and is unique of its kind. Indeed, the whole pneumatic system of the central office is an "exhibit" of the most interesting kind, and an object of just pride with those who have it in charge.—The Gentleman's Magazine.

The Parts That Do Not Grow Old.

"In his work on the senile heart, Dr. Balfour tells us," says the Medical Times, New York, July, "that there are two parts of the human organism which, if wisely used, largely escape senile failure. These two are the brain and the heart. Persons who think have often wondered why brain workers, great statesmen and others, should continue to work with almost unimpaired activity up to a period when most of the organs and functions of the body are in a condition of advanced senile decay. There is a physiologic reason for this, and Dr. Balfour tells us what it is. The normal brain, he affirms, remains vigorous to the last, and that because its nutrition is especially provided for. About middle life, or a little later, the general arteries of the body begin to lose their elasticity and to slowly but surely dilate. They become, therefore, much less efficient carriers of the nutrient blood to the capillary areas. But this is not the case with the internal carotids, which supply the capillary areas of the brain. On the contrary, those large vessels continue to retain their pristine elasticity, so that the blood pressure remains normally higher than within the capillary area of any other organ in the body. The cerebral blood paths being thus kept open, the brain tissue is kept better nourished than the other tissues of the body. Who is there of those who have passed middle age that will not rejoice to find such admirable physiological warrant for the belief that the brain may continue to work almost to the very last hour of life?"

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RECENTLY PATENTED INVENTIONS.

Engineering.

ROTARY ENGINE.—David Berry, Fish Rock, Cal. This engine has a cylinder in the head of which is mounted a drive shaft on which is a wheel provided with a number of pistons sliding radially to engage the sides between the rim of the wheel and the rim of the cylinder, the pistons being forced into outermost position by springs, so that in passing over a permanent abutment projecting into the sides between the wheel and cylinder, the pistons slide inwardly owing to the yielding of the springs. The construction is designed to be durable and very effective, the arrangement permitting of conveniently reversing the engine when desired.

Mechanical.

FLANGE WRENCH.—William H. Brock, Brooklyn, N. Y. This wrench is especially adapted for screwing flanges upon pipes, and may be used right hand or left hand, to remove a flange as well as screw one on. The head has a biting face on each side, and is provided with a handle and an arm pivotally connected to the head and extending beyond the biting faces, a stud projecting parallel to its pivot pin.

MACHINE FOR DRILLING COUNTERSINKS.—Lemuel Churchill, Three Oaks, Mich. For forming oblong countersinks for the reception of elliptical bolt heads, this inventor provides a drilling tool with a cutting head having a smooth non-cutting point extending beyond the cutting edges of the head, and forming a fulcrum for the tool. The shank of the tool is secured in a socket of a drill shaft turning in a sleeve sliding and turning in a block which slides in a segmental slot in the frame, which may be readily raised and lowered to bring the cutting edges to desired position.

PUMPING JACK.—Emmett R. Curtin, St. Mary's, Ohio. This is a simple and inexpensive jack which may be easily erected on the derrick of an oil well to form a smooth working connection with the pump rod, without bending or cutting it, and which may be connected with an ordinary reciprocating piston, the jack to be worked either side up. The body of the jack is in the form of a bell crank, consisting preferably of two parallel pipes arranged so that their upper ends lie horizontally and their lower ones vertically, the pipes being connected on opposite sides of their elbows by tie plates. The pipe bell crank is seated and bolted in longitudinal grooves of a saddle, and the pump rod is connected with the pipes by a holder through which the pipes slide as they move up and down when the pump rod is reciprocated.

WOOD STRIP CUTTING MACHINE.—Robert Schleicher and Charles Heimerdinger, Louisville, Ky. For cutting strips for lining boxes and other purposes to the desired length and also to the miter, these inventors have devised a machine in which a reciprocating cutter head carries the knives for cutting and mitering the strips, while a variable feed mechanism operates in conjunction with the head to feed the strip forward to the desired length during the return stroke of the head. The machine may be made single, but is preferably constructed with double tables and a double cutter head, when one operator can conveniently attend to it.

COMPOUND DRIVING GEAR.—Thomas H. Savery, Wilmington, Del. A fast speed pulley and a slow speed pulley are, according to this improvement, both adapted to be connected with the driving shaft of a machine, a friction clutch locking one to the driving shaft and a positive clutch locking the other, either clutch being engaged at will, while the positive or slow-driving clutch will not be disengaged before the friction or fast-driving clutch is put in engagement. If desired, neither clutch will be in engagement. The improvement relates especially to paper machines, permitting the couchers, first press, second press and calenders to be driven at a very fast speed and started simultaneously or singly without danger of shock.

Miscellaneous.

ELECTRIC ANNUNCIATOR.—William J. Clarke, Trenton, Canada. This improvement is applicable to all electric call bell systems requiring more than ten indications. By its use eleven wires are required for the first ten rooms, then one additional wire for every ten rooms up to one hundred, and after that only one additional wire for every one hundred rooms. The annunciator face has drops in segregated groups, instead of for each single room, the number of a room being indicated by the falling of a drop in two or more groups, as room 125 would be indicated by drop 1 in hundreds group, drop 2 in tens group, and drop 5 in units group, all operated by the single push button of room 125, and only thirty drops being required for a thousand rooms.

SWING-BACK CAMERA ADJUSTER.—Henry J. Hall, Wickford, R. I. This is a horizontal swing attachment permitting the camera to swing to the right or left from normal position about thirty degrees, the attachment being applicable to any form of camera and easily manipulated. It consists of a support on which is pivoted a sill, both sill and support having extensions one above the other, each having a transverse slot, and one of the extensions having a longitudinal slot, adjacent to which is a rack, while carried by a lever is a pin adapted to travel in the slots of the extensions, the pin carrying a pinion which may be locked.

FILTER.—Charles Asburst, Paris, Ky. This is a device for use in connection with the discharge spouts of buildings, the first water passing to the filter being passed to a waste pipe, while succeeding portions go through the filtering material to the cistern or other receptacle. When the rain ceases the contents of the filter are automatically drained in such manner that the drainage washes out and discharges into the waste outlet all sediment and other accumulations, leaving the filter in a cleanly condition.

RIDING SADDLE.—Jesse D. Padgitt, Dallas, Texas. This saddle has a short, rigid tree, to the rear edge of which are secured flexible leather pieces extending the length of the body of the saddle, to serve as a filling and stiffening, top and under pieces being sewed together at their edges to inclose the filling. The saddle is thus designed to be more comfortable to the rider and better adapted for horses having backs differing in shape, from its front portion being rigid and its body and rear portion flexible.

HARNESS SADDLE.—John D. Fletcher, Murfreesborough, Tenn. This saddle has a leather backing to which a detachable leather lining is united by lacing cords, and two inflatable rubber cushions are arranged one on each side of the middle line of the pad within the lining, the cushions being provided with a valved nipple and solid ends with eyelets through them, through which are passed cords to hold them in place within the outer case. The saddle is designed to promote the comfort of the animal, always remaining soft and cool and readily adapting itself to the shape of the horse's back.

MOISTENER AND PAPER WEIGHT.—Harvey R. Harris, Michigan City, Ind. The casing of this device has a weighted lower portion and an upper compartment with inclined bottom, the sponge or moisture-receiving substance being placed in the upper compartment, which has a forward overhanging portion open at the bottom, whereby the moisture will always seek the lower exposed part of the sponge, the part to be pressed by the article to be moistened.

TANK SUPPLY VALVES.—Augustus E. Smith, Brookville, Pa. This invention provides a controlling device for valves in water closet tanks, designed to perfect the working efficiency of the supply valve and insure its positive closing when the tank is filled to the point of overflow, also permitting of regulating the amount of overflow after the tank is filled. Combined with the supply valve is a fixed pneumatic casing apertured to permanently communicate with the tank and having an air escape of reduced diameter, whereby the liquid rises slower in the casing than in the tank when the supply valve is open, a float contained in the casing being operatively connected to the valve.

ADVERTISING DEVICE.—Joseph T. Craw, Jersey City, N. J. A card or case, according to this invention, comprises several members or leaves, but appears to have but two leaves, although it has actually six pages. The card or case may be opened from opposite sides to display different pages, and it may contain one or more pockets for railroad tickets, cards, etc. The entire device may be shaped in blank form, and it may be very inexpensively produced.

Designs.

ELECTRIC LIGHT SHADE.—Harrison D. McFaddin, East Orange, N. J. In this shade one side presents an inclosed face consisting of a shell figure, the ribs widening out to a leaf-like form at their outer or upper ends, the general effect being that of a ribbed shell supported at one side so that a portion only of the globe of the light will be exposed.

STANDARD OR BASE FOR SCALES.—Edward F. Jones, Binghamton, N. Y. This standard has a stem projecting laterally from its base, the stem terminating in a number of leaves representing modified clover leaves.

INTERNAL COVER FOR CULINARY VESSEL.—Matej Kratky, Hemingford, Neb. This is a round cover with edge beveled downward and outward, the edge having alternate recesses and projections.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

THE NATURAL HISTORY OF AQUATIC INSECTS. By Professor L. C. Miall, F.R.S., with illustrations by A. R. Hammond, F.L.S. London and New York: Macmillan & Company. 1895. Pp. 395. 16mo, 115 illustrations. Price $1.75.

A delightful work for the microscopist. The author has attempted to help those naturalists who take delight in observing the structure and habits of living animals, and also to revive an interest in the writings of certain old zoologists—Swammerdam, Reaumur, Lyonnet and De Geer—who are at present unjustly neglected.

HOW A GOOD CAR DIFFERS FROM A BAD ONE, AND HOW TO GET IT. Saint Louis: Published by the Brownell Car Company. Pp. 171. Oblong 16mo, 55 illustrations.

An excellent specimen of bookmaking and a good example of what the manufacturer of to-day deems necessary to put into the hands of prospective buyers to enable them to judge of the merits of the goods offered. The Brownell Car Company make the now well known accelerator, and the great advantages of this car are shown. One view of a crowd seen from above, showing the people's heads, is a very curious illustration.

Messrs King & Brothers, of New York and Albany, have just published an Outline of the Infringement of Patents for Inventions, not Designs, of which the author is Mr. Thomas B. Hall, of the Cleveland bar. Mr. Hall has divided the subject into four parts which, he explains, are the four questions to be logically considered in an infringement suit. These are: first, the license under the patent by which use of the patented article may be justified; second, the identity of the patented invention and the infringing device, the absence of such being evidence of non-infringement; third, the validity of the patent, this being, of course, essential to recovery; and fourth, that which is to be recovered for unlawful infringement. These subjects the author successively considers, and the law of each question is stated with a conciseness only consistent with the brevity of the work. There is appended a table of cases arranged with reference to their subject matter, by means of which one may be directed to the authorities for the law, and also an index of subjects. Thus equipped the book is a fine summary of the law, and an invaluable guide to an exhaustive consideration of every topic within the purview of its title.

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SCIENTIFIC AMERICAN BUILDING EDITION.

JULY, 1895.—(No. 117.)

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1. An elegant plate in colors showing a residence at Bridgeport, Conn., recently erected for Christian M. Newman, Esq. Three perspective elevations and floor plans. Cost $5,500 complete. Architect, Mr. Samuel D. P. Williams, Williamsburg, N. Y.
2. A handsome residence at Glenwood, N. Y., recently erected for Wm. R. Innis, Esq. Two perspective elevations and floor plans. An attractive design.
3. A modern cottage of attractive design recently erected at New Rochelle, N. Y. Perspective elevation and floor plans. Estimated cost $3,000. Architect, C. B. J. Snyder, New York City. Design in the American order of architecture.
4. A summer cottage at Great Diamond Island, Me., recently erected for Edward L. Goding, Esq. Two perspective elevations and floor plans. Cost $2,500 complete. A picturesque design. Mr. A. Dorticos, architect.
5. An attractive dwelling at Oakwood, Staten Island, recently erected for Mrs. Margaret Dutche. Cost $3,800 complete. Two perspective elevations and floor plans. Architect, Mr. Herman Fritz, Jr., Passaic, N. J.
6. A Colonial dwelling at Springfield, Mass., erected for Messrs. J. D. and W. H. McKnight, at a cost of $6,000 complete. Two perspective elevations and floor plans. A pleasing design. Architect, Mr. G. Wood Taylor, Boston, Mass.
7. Colonial house recently erected at Groton, Mass., in the style of Longfellow's home. Perspective elevation and floor plans. Architects, Messrs. Child & De Goll, New York.
8. View of the Hotel Majestic, New York. One of the finest hotels in the world. Architect, Mr. Jacob Rothschild.
9. A cottage in the Colonial style, recently erected for Margaret Deland at Kennebunkport, Me. A picturesque design. Perspective elevation and floor plans. Mr. Henry P. Clark, Boston, Mass., architect.
10. Suggestions in corner decorations.
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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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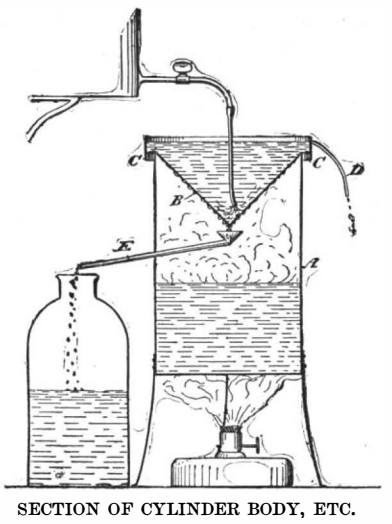
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6587) R. L. M., Jr., says: How can I make a portable distillery? A. Photographers away from cities are often at their wits' end to procure water of assured purity. The following cheap, portable and not in the way device may help them in their difficulties. A cylinder 13 inches high by 7 inches in diameter, with bottom made preferably of copper, with three legs of strap iron high enough to raise the cylinder 6 inches from the ground. To the top of the cylinder a conical lid, 8½ inches in diameter (outside) and 5 inches in height from base to apex of cone, provided with a flange to fit snugly inside the cylinder. Near the base of the cone a tube 3 inches long is inserted. About 5 inches from the top of the cylinder a tube, 10 inches long, is passed through, terminating in a small furnace exactly under the apex of the cone when the cover is on. The other end projects about 3 inches on the outside of the cylinder. Fill the cylinder about one-half full with ordinary water. If pressed for time, hot water may be used. Adjust the cover and place the apparatus over a gas or oil stove, and, by means of an India rubber tube connected with a tap, pass a gentle stream of cold water into the cover, allowing the overflow to pass out through the tube in the cover. When the water boils, the steam rises and settles on the cone cover, where it is condensed by the cold water in the cover, and it is then collected in the funnel and runs down the long tube into a bottle or other receptacle.



SECTION OF CYLINDER BODY, ETC.

A, 13 inches high and 7 inches in diameter. B, conical lid, 8½ inches in diameter and 5 inches in height from apex to base of cone. C, C, flanges to fit snugly inside the cylinder. D, tube 3 inches long. E, tube 10 inches long, terminating in a small funnel. Still was invented, I believe, by Mr. C. C. Neves, of England.

(6588) A. J. McM. asks for some information regarding India rubber. A. India rubber is the product of many euphorbiaceous plants. We get most of it from the Brazils and Central America. In Brazil it is obtained from the Siphonia elastica, which grows to a height of between 50 to 60 feet, and in Central America it is obtained from Castilloa elastica. Most of that we now use comes from Central America, where the juice is

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simply collected in cups, from incisions made in the bark. To coagulate the milky juice and convert it into rubber fit for exportation, the juice of a vine called achuca is mixed with it, and so powerful is its action that five or six minutes is sufficient to produce coagulation. The Brazilian method slightly differs. The juice is first collected in clay bowls; it is then smeared over various shaped moulds, made also in clay and taking the form of bottles, balls, spindles, etc. Successive coats are laid on, each one having previously been allowed to thoroughly dry, either in the sun or the smoke of a fire, which blackens it. When a sufficient thickness is obtained the clay is washed out, leaving the India rubber ready for exportation. The trees yield twenty or thirty gallons of juice, and when we consider that each gallon will produce two pounds of market India rubber, the harvest is not so bad. Other trees producing caoutchouc are Siphonia brasiliensis, S. lutea, and S. brevifolia.

(6589) **S. W. C. says: Can you give me** some data for calculations relative to air? A. 1. To find the quantity of nitrogen by volume corresponding to 1 volume of oxygen, multiply by 3·770992. 2. To find the quantity of oxygen by volume corresponding to 1 volume of nitrogen, multiply by 0·265182. 3. To find the quantity of nitrogen by weight corresponding to 1 part by weight of oxygen, multiply by 3·313022. 4. To find the quantity of oxygen by weight corresponding to 1 part by weight of nitrogen, multiply by 0·301839. 5. To find the quantity of nitrogen by volume corresponding to 1 part by weight of oxygen, multiply by 2·6365411. 6. To find the quantity of oxygen by volume corresponding to 1 part by weight of nitrogen, multiply by 0·2730071. 7. To find the quantity of nitrogen by weight corresponding to 1 part by volume of oxygen, multiply by 3·6629154. 8. To find the quantity of oxygen by weight correspondtng to 1 part by volume of nitrogen, multiply by 0·3792848.

(6590) **C. T. V. asks: 1. Why is electrical** apparatus protected from lightning by lightning arresters? A. To convey away the lightning so as to prevent injury to the apparatus and the operators. 2. How to find the horse power of steam engines. A. Multiply the area of the piston in inches by the pressure of steam per square inch, then multiply this product by the speed of the piston in feet per minute and divide by 33,000. This leaves friction out of the account. 3. How to determine the proper size of fuses for electric light wires. A. As fuse wires made by different makers melt at different temperatures, an actual test of each kind of metal or alloy is required for the different diameters and lengths. Some use pure tin, others tin and lead. 4. Is it necessary for the neutral wire of a three-wire circuit to be equal to the capacity of the two outside wires combined? Why? A. No current goes by the neutral wire, unless there is a difference in the number of lamps on opposite sides thereof. In this case the neutral wire takes the difference in the current, and this only. For this reason this wire may be much smaller than the outside conductors.

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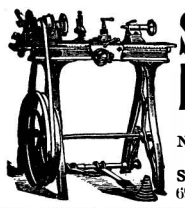

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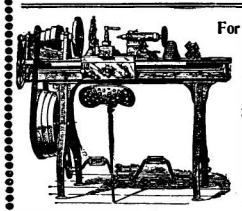

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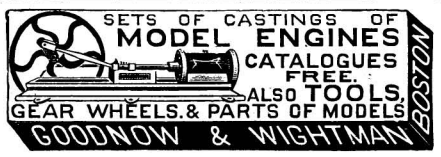

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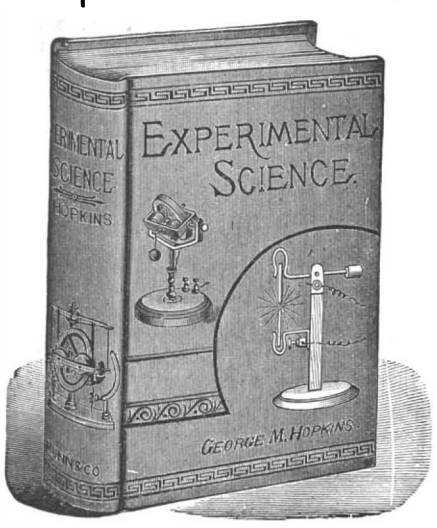

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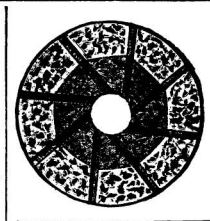

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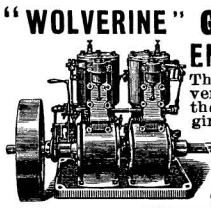

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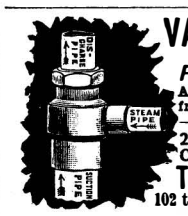

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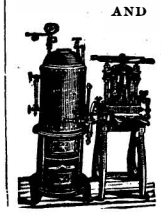

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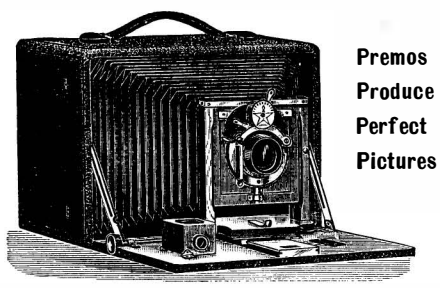

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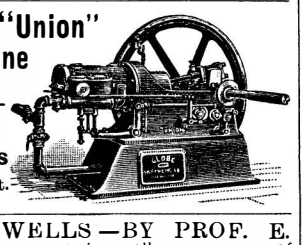

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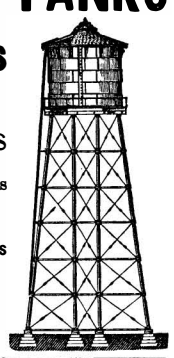

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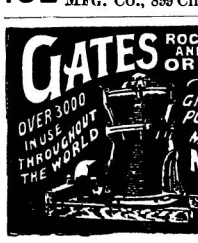

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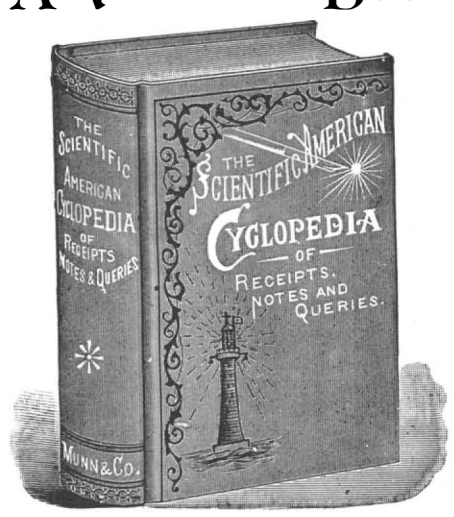

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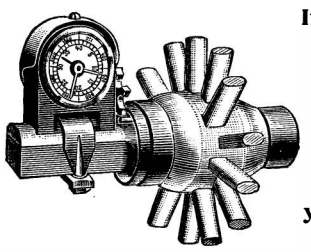

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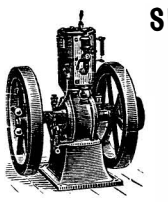

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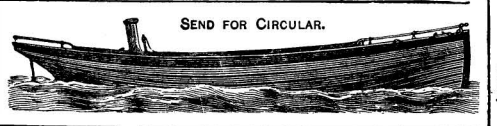

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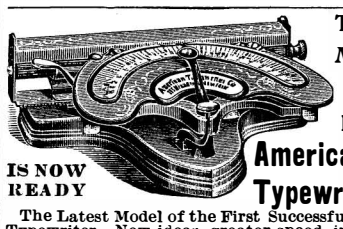

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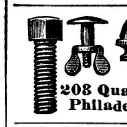

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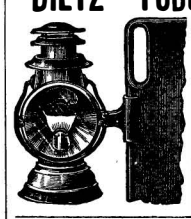

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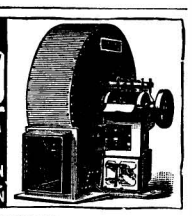

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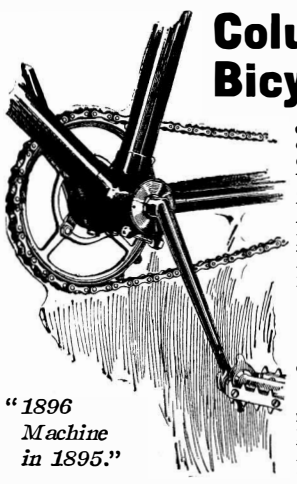

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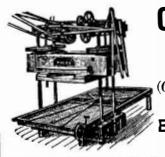

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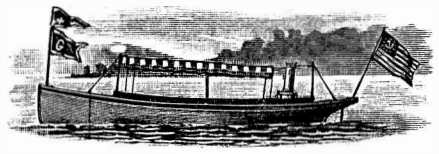

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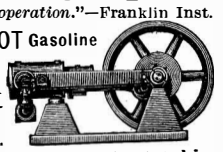

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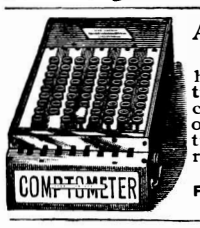

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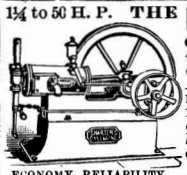

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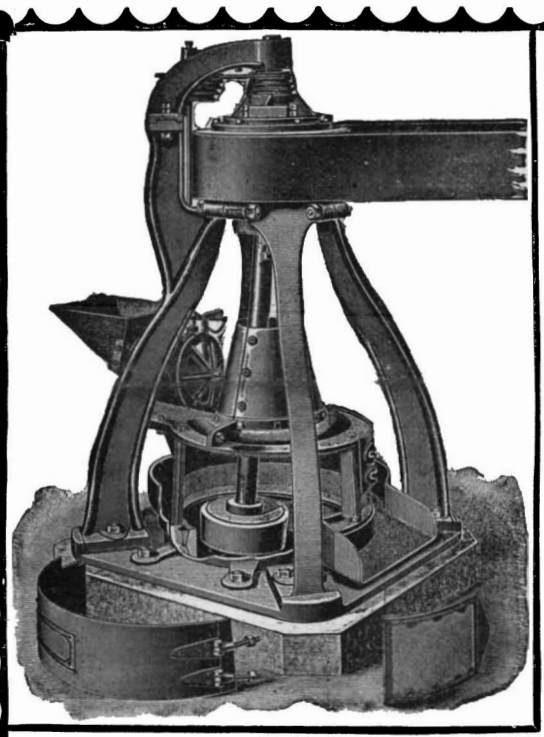

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